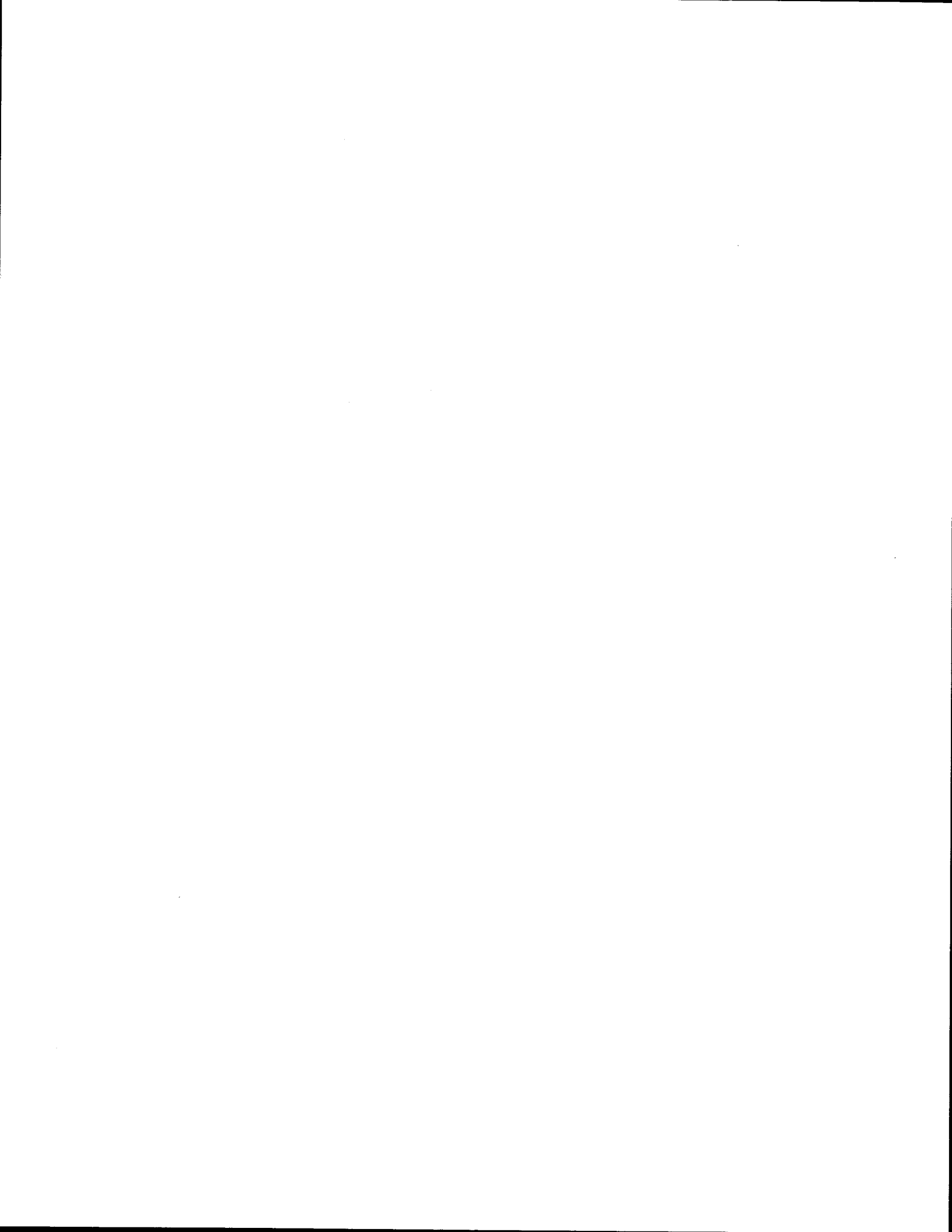


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**A REPORT ON THE USERS MANUAL FOR  
THE MICROCOMPUTER VERSION OF PASSER III-88**

by

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**Research Report 478-1  
Research Study Number 2-18-85-478  
Study Title: Operations and Design Applications Using PASSER III-85**

Sponsored by the

**Texas State Department of Highways and Public Transportation  
In Cooperation with the  
U.S. Department of Transportation, Federal Highway Administration**

September 1988

**TEXAS TRANSPORTATION INSTITUTE  
The Texas A&M University System  
College Station, Texas 77843**

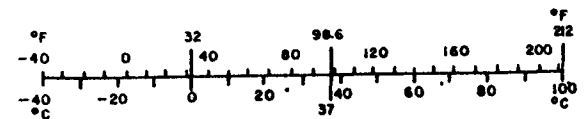
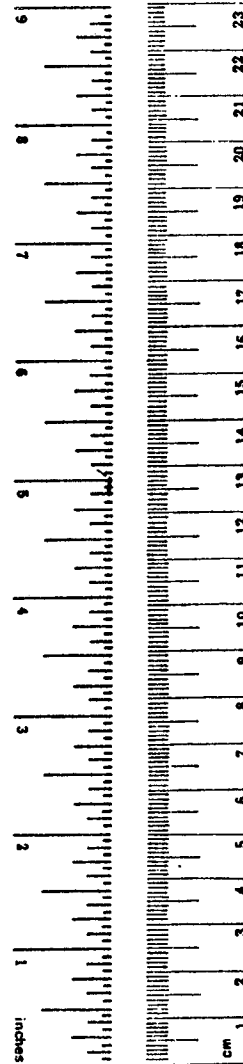
## METRIC CONVERSION FACTORS

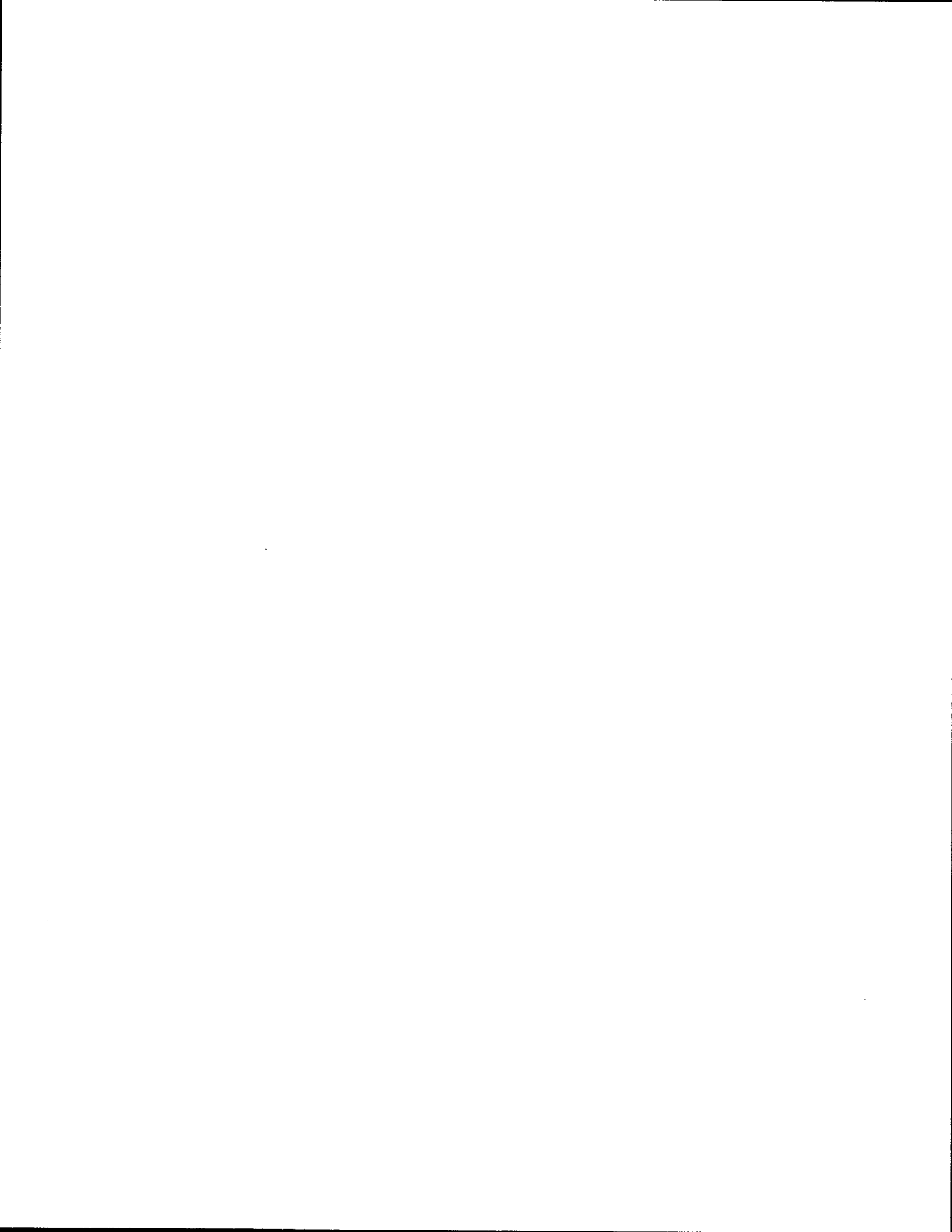
### Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	6.5	square centimeters	cm <sup>2</sup>
ft <sup>2</sup>	square feet	0.09	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yards	0.8	square meters	m <sup>2</sup>
mi <sup>2</sup>	square miles	2.6	square kilometers	km <sup>2</sup>
	acres	0.4	hectares	ha
<b>MASS (weight)</b>				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
<b>VOLUME</b>				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.96	liters	l
gal	gallons	3.8	liters	l
ft <sup>3</sup>	cubic feet	0.03	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.76	cubic meters	m <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

### Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
<b>AREA</b>				
cm <sup>2</sup>	square centimeters	0.16	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	1.2	square yards	yd <sup>2</sup>
km <sup>2</sup>	square kilometers	0.4	square miles	mi <sup>2</sup>
ha	hectares (10,000 m <sup>2</sup> )	2.5	acres	
<b>MASS (weight)</b>				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
<b>VOLUME</b>				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m <sup>3</sup>	cubic meters	35	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.3	cubic yards	yd <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F





## **TRADEMARK**

PASSER (trademark application pending) is a mark of the Texas Transportation Institute (TTI). As such, any use of this mark must have prior written approval from TTI.

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## ABSTRACT

This report describes the user's manual for the microcomputer version of PASSER III-88, a practical computer program designed to assist transportation engineering professionals in the analysis of pretimed or traffic-responsive, fixed-sequence signalized diamond interchanges. The program can evaluate existing or proposed signalization strategies, determine signalization strategies which minimize the average delay per vehicle, and calculate signal timing plans for interconnecting a series of interchanges along continuous one-way frontage roads. In addition, the program can evaluate the effectiveness of various geometric design alternatives, e.g., lane configurations, U-turn lanes, and channelization.

The report describes procedures for installing the program on your microcomputer and use of the three interactive, user-friendly menus for data entry and editing, running the program, and managing input and output files. Coding instructions, output interpretation, and background information are described and supplemented with examples from the program. Input and output from two example problems, an isolated interchange and a frontage road progressive system, are also included in the report. Several appendices provide additional information for advanced users of the program.

KEY WORDS: Diamond Interchanges, Signalization, Frontage Road Progression, Delay-Difference of Offset, PASSER III

## EXECUTIVE SUMMARY

With increasing demands on the urban freeways in Texas, frontage roads are becoming more important as a source of additional capacity for the freeway's main lanes. Additional capacity in the freeway corridor is especially beneficial during rush hour, maintenance, or incident conditions. It is essential, however, that the signalized intersections along the frontage roads operate efficiently in order to make the best use of the existing facilities. Toward this goal, several Texas HP&R (Highway Planning and Research) studies have addressed objectives related to improving frontage road-freeway design and operations. This report presents the user's manual for the microcomputer version of the diamond interchange signalization program, PASSER III-88, developed as a part of this research.

PASSER III-88 is a practical computer program designed to assist transportation engineering professionals in the analysis of pretimed or traffic-responsive, fixed-sequence signalized diamond interchanges. The program can evaluate existing or proposed signalization strategies, determine signalization strategies which minimize the average delay per vehicle, and calculate signal timing plans for interconnecting a series of interchanges along continuous one-way frontage roads. In addition, the program can evaluate the effectiveness of various geometric design alternatives, e.g., lane configurations, U-turn lanes, and channelization.

This report contains step-by-step procedures for installing the program on either your two-floppy or hard-disk drive microcomputer and for use of the three interactive, user-friendly menus for data entry and editing -- MAIN, EDIT, and OUTPUT. Instructions for running the program and managing input and output files are also included in the report. Detailed instructions for entering and editing data and interpreting output are described and supplemented with example printouts from the program. Input and output from two example problems, an isolated interchange and a frontage road progressive system, are also included in the report. Several appendices provide additional information for advanced users of the PASSER III-88 program.

## IMPLEMENTATION

The findings of this study should be helpful to Texas State Department of Highways and Public Transportation traffic engineering professionals who plan, design, operate, and maintain signalized diamond interchanges. The microcomputer version of PASSER III-88 developed in this research will be available statewide to SDHPT engineers. Use of the program will result in improved geometrics and timing plans and will substantially reduce delay costs at the signalized diamond interchanges in Texas. The program's use will also improve the efficiency of the state's traffic engineering professionals in that the average turnaround time of the microcomputer version of the program is approximately 10 times faster than the previous mainframe versions of the program. Thus, state personnel should be able to analyze more alternatives in a shorter amount of time.



## **ACKNOWLEDGEMENTS**

The research reported herein was performed as a part of a study entitled "Operations and Design Alternatives Using PASSER III-85" by the Texas Transportation Institute and sponsored by the Texas State Department of Highways and Public Transportation in cooperation with the U.S. Department of Transportation, Federal Highway Administration. Dr. Daniel B. Fambro of the Texas Transportation Institute served as research supervisor, and Mr. Rene U. Garza of the Texas State Department of Highways and Public Transportation served as technical coordinator.

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## **DISCLAIMER**

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the Texas State Department of Highways and Public Transportation. This report does not constitute a standard, specification, or regulation.

Please be advised that no warranty is made by the Texas Department of Highways and Public Transportation, the Federal Highway Administration, or the Texas Transportation Institute as to the accuracy, completeness, reliability, usability, or suitability of the computer program and its associated data and documentation. No responsibility is assumed by the above parties for incorrect results and/or damages resulting from the use of the PASSER III-88 program package.

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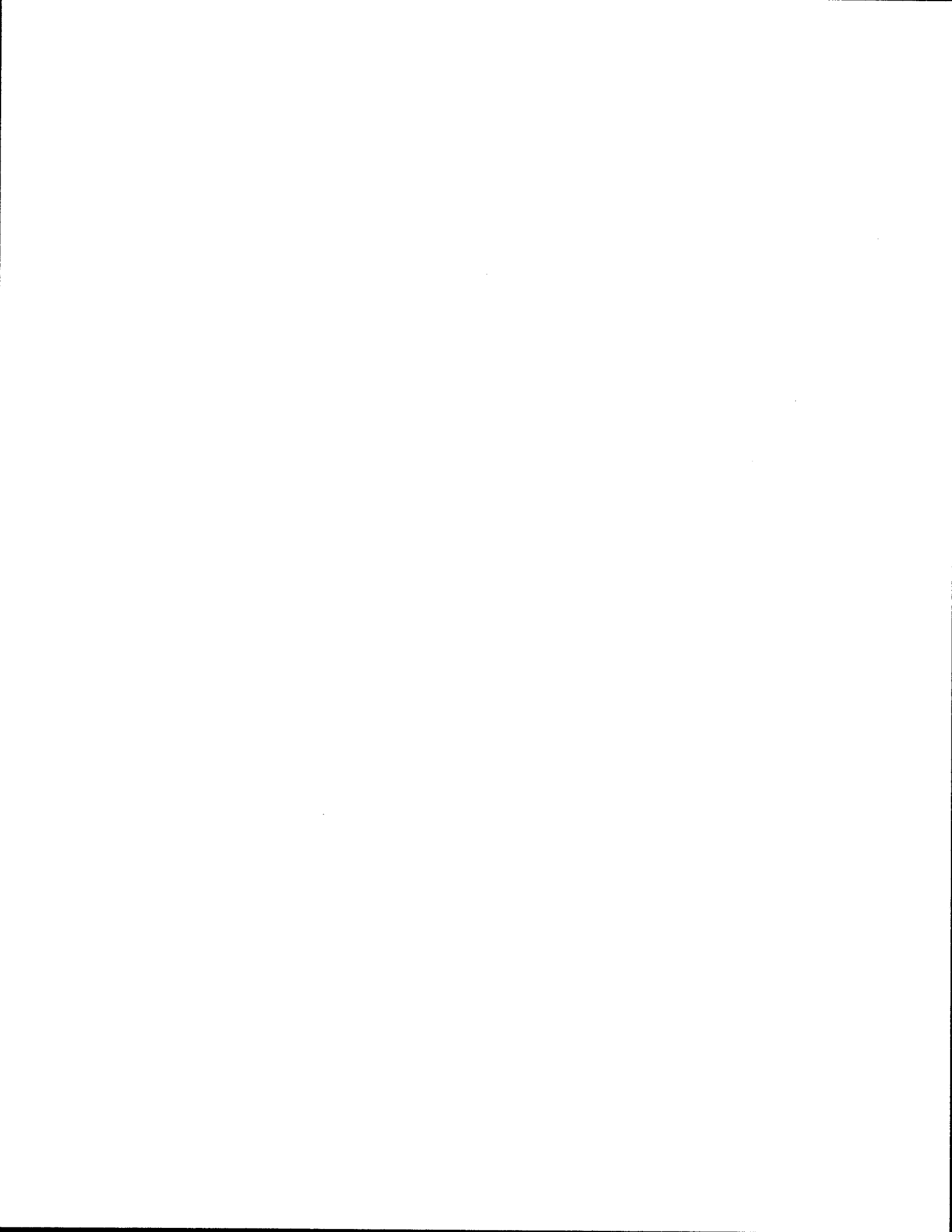
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## I. INTRODUCTION

### Background

PASSER III-88 (Progression Analysis and Signal System Evaluation Routine) is one of a series of signalization programs developed by the Texas Transportation Institute (TTI) for and in conjunction with the Texas State Department of Highways and Public Transportation (SDHPT). It was designed to assist traffic engineers in analyzing pretimed or traffic-responsive, fixed-sequence signalized diamond interchanges. The program can evaluate existing or proposed signalization strategies, determine signalization strategies which minimize the average delay per vehicle, and calculate signal timing plans for interconnecting a series of interchanges on one-way frontage roads.

The basic theory of the progression option of the program was developed and tested by TTI in the Dallas Corridor Project sponsored by the Federal Highway Administration and documented in a previous publication (1). PASSER was adapted for off-line processing and analysis purposes in Highway Planning and Research (HPR) Project 165, and a level-of-service evaluation for the approaches to an intersection was undertaken in HPR Project 203. Both projects were sponsored by SDHPT, and their results have been documented in several reports (2, 3).

The optimization and evaluation portion of PASSER III was developed in HPR Project 178, and the first version of the program was released in August, 1977 (4, 5). Since that time, experience gained by SDHPT personnel and other users have resulted in several suggested modifications and/or improvements to the basic program. In response to these suggestions, enhanced versions of the program, PASSER III-80 and PASSER III-84, were released in 1980 and 1984 (6). This report describes the next step in this evolutionary process, a microcomputer environment system for PASSER III-88.

### Getting Started

PASSER III-88 is designed for use on IBM PC, XT, AT, and IBM compatible microcomputers with at least 512K of random access memory (RAM), a DOS 2.0 or higher version of operating system, and either two-floppy or one hard-disk drive(s). The basic program is written in FORTRAN-77 and the interactive input-output routines in TURBO PASCAL; however, neither compiler is necessary in order to run PASSER III-88; i.e., the source code and interactive routines have already been interpreted.

PASSER III-88 is distributed on a single 360K floppy diskette; however, the program must be installed on your microcomputer before it can be used. Depending on the available hardware and user preference, the program can be installed in a number of configurations. These configurations will be discussed in detail later. For your ease, two batch files are supplied on the distribution diskette. These files automatically install specified



configurations of the program for either two-floppy or hard-disk drive(s) computers.

**Configuring for a Two-Floppy Drive Machine.** To install the program on a two-floppy drive machine, the following procedure should be followed:

1. Boot up your machine with your DOS 2.0 or later version diskette in drive A.
2. Label a new diskette "DISK A", place it in drive B and type  
A:\>FORMAT B:/S
3. Label another new diskette "DISK B", place it in drive B and type  
A:\>FORMAT B:
4. Remove disk labeled "DISK B" from drive B.
5. Replace DOS diskette in drive A with the PASSER III-88 distribution diskette.
6. Type A:\>FLOPINST and follow the directions given on screen.

The two new diskettes are now ready for use on your two-floppy drive machine. As they are now bootable, it is recommended that you boot-up your machine with the PASSER III-88 diskettes in their respective disk drives whenever you wish to use the program. The original distribution diskette should be kept as a backup and stored in a cool, dry place. To access and start using PASSER III-88, simply type

```
A:\>PASSER3 filename
```

Where "filename" is an optional parameter and is the name of the work file (without .DAT or .OUT extension) that you want to work with.

**Configuring for a Hard-Disk Drive Machine.** To install the program on a hard-disk drive machine, the following procedure should be followed:

1. Insert the PASSER III-88 distribution diskette in drive A. Change the default drive to A.
2. Type A:\>HDINSTAL and follow the directions given on screen.

The program is now ready for use on your hard drive machine. To use the program, simply type:

```
C:\> PASSER3 filename
```

Where "filename" is an optional parameter and is the name of the desired file (without .DAT or .OUT extension) that you want to work with.

You may wish to configure PASSER III-88 for your computer in a different manner than provided by the install programs on the distribution diskette. A

detailed description about configuring PASSER III-88 for your microcomputer system is given in Appendix A.

## Running the Program

Once you have called up PASSER III-88, the first screen to appear will be the title screen which prompts you for the correct date. If the date is correct or you do not wish to change it, press "Y" or "Enter" to continue. If you wish to change the date, press "N" and the program will prompt you to enter a new date in the form "mm/dd/yy" and then ask if the new date is correct. It is not absolutely essential that the date be correct, as it is only used for identification purposes and not in the program's execution.

The second and third screens to appear will be the disclaimer and copyright screens. Once you are familiar with one screen's contents, you can proceed to the next screen by pressing any key. The title, disclaimer, and copyright screens will not reappear as long as you stay within PASSER III-88; i.e., they only appear upon entry into the program. Experienced users will probably skip quickly over these screens by pressing "Enter" at the prompts.

The fourth screen to appear will be the **MAIN MENU**. It is one of three interactive menus - **MAIN**, **EDIT**, and **OUTPUT** - from which you will work. These menus, their options, and relationships to one another are shown in Figure 1. Note that the **EDIT MENU** and **OUTPUT MENU** can both be accessed from the **MAIN MENU**, but not from each other. Thus, as the name might imply, all actions are initiated from the **MAIN MENU**. Interactive error messages are displayed if you select an invalid option from **MAIN MENU** or if incorrect data is entered on subsequent screens. A description of these interactive error messages is given in Appendix B. Each of the menus is discussed in the following sections.

**MAIN MENU.** This menu provides six options which are selected by pressing the first letter of the desired option. These options pertain to data manipulation, program execution, and menu selection.

**File - Data Set Choices.** This option allows you to change the workfile name. In addition, you may change the current path, copy a file, or delete any file. A detailed description of this option is given in the section entitled File-Data Set Choices.

**Edit - Define or Modify Data.** This option transfers you to the **EDIT MENU** wherein the active data set can be previewed and/or modified. When the current directory does not contain a data set name that is the same as the current work data set, this option will allow the creation of a new data set.

**Run - PASSER III-88.** This option checks the data for any major errors and, if there are none, runs the program. Upon completion of the run, you will automatically be transferred to the **OUTPUT MENU**.

```

P A S S E R   I I I   -   8 8
Texas Department of Highways & Public Transportation
Version 1.0

MAIN MENU

File   - Data Set Choices
Edit   - Define or Modify Data
Run    - PASSER III - 88
Input  - View or Print
Output - View or Print
Quit   - Return to System

ENTER YOUR CHOICE -->

Input = A:\TEST01.DAT
Output = A:\TEST01.OUT

Run -----Freeway-----
01 USERS MANUAL EXAMPLE 1

Escape key to exit to the System (DOS)

```

```

P A S S E R   I I I   -   8 8
Texas Department of Highways & Public Transportation
Version 1.0

EDIT MENU

General - Freeway Identification
Signal  - Phasing Data
Movement - Interchange Data
Progression - Link Geometry
Return  - to MAIN MENU

Edit Interchange = 1: EISENHAUER

ENTER YOUR CHOICE --> R

Esc:exit screen   PgUp/PgDn:next interchange

```

```

P A S S E R   I I I   -   8 8
Texas Department of Highways & Public Transportation
Version 1.0

OUTPUT MENU

Problem - Identification Data
Movement - Interchange Data
Interchange - Phasing Data
Link - Geometry Data
Delay - Offset Diagrams
Optimal - Progression Solution
Frontage Rd - Progression Information
General - Signalization Information
Signal - Phasing Information
Time - Space Diagram
Entire - Output File
Return - To MAIN MENU

ENTER YOUR CHOICE --> R
Print File = A:\TEST01.OUT

Escape key to exit screen

```

Figure 1. Interactive Menus Used by PASSER III-88.

**Input - View or Print.** This option allows you to view or print active data sets in the format used by the FORTRAN program.

**Output - View or Print.** This option transfers you to the **OUTPUT MENU** wherein the active output file can be viewed and/or printed.

**Quit - Return to System.** This option returns you to the DOS operating system.

**EDIT MENU.** This menu provides five options which pertain to data entry and editing. They are selected by pressing the first letter of the desired option.

**General - Freeway Identification.** This option allows you to enter or edit basic identification data and also the types of analyses to be performed.

**Signal - Phasing Data.** This option allows you to enter or edit basic interchange and signal phasing data.

**Movement - Interchange Data.** This option allows you to enter or edit the traffic volumes, saturation flows, and minimum greens for each movement at the interchange.

**Progression - Link Geometry.** This option allows you to enter or edit link geometry, speeds, and distances required for a frontage road progression solution. This option is not applicable in the analysis of a single interchange.

**Return - To MAIN MENU.** This option returns you to the **MAIN MENU**.

**OUTPUT MENU.** This menu provides 12 options which pertain to viewing and/or printing either a portion of or the entire output data file. They are individually selected by pressing the first letter of the desired option.

**Problem - Identification Data.** This option allows you to view and/or print the title and requested analyses pages.

**Movement - Interchange Data.** This option allows you to view and/or print the volumes, saturation flows, and minimum greens for each movement at both intersections of the interchange.

**Interchange - Phasing Data.** This option allows you to view and/or print the requested interchange phasing and internal delay-offset information.

**Link - Geometry Data.** This option allows you to view and/or print the link geometry data for the progressive system. This section will not contain output unless a progression solution was requested; i.e., more than one interchange was coded.

**Delay - Offset Diagrams.** This option allows you to view and/or print plots of delay versus internal offset for each combination of phasing sequence and cycle length requested. This section will not contain output unless a delay-offset analysis was requested.

**Optimal - Progression Solution.** This option allows you to view and/or print summary statistics for the optimal progression solution. This section will not contain output unless a progression solution was requested.

**Frontage Rd - Progression Information.** This option allows you to view and/or print each interchange's phasing sequence, internal and external offset, and total travel times for the optimal progression information. This section will not contain output unless a progression solution was requested.

**General - Signalization Information.** This option allows you to view and/or print each interchange's green splits, volume to capacity ratios, average delays, queue storage ratios, and corresponding levels of service.

**Signal - Phasing Information.** This option allows you to view and/or print each interchange's phasing sequence and phase interval status lengths.

**Time - Space Diagram.** This option allows you to view and/or print the time-space diagram for the optimal progression solution. This section will not contain output unless a progression solution was requested.

**Entire - Output File.** This option allows you to view and/or print the entire output file.

**Return - To MAIN MENU.** This option returns you to the MAIN MENU.

### **File-Data Set Choices**

Selection of this option from the MAIN MENU allows you to specify the current work file by inputting its name along with its drive and path. In addition, you can view the directory of all data and output files, copy a file, and/or delete a specified file. The top part of Figure 2 illustrates this screen. If the directory listing is longer than 20 lines in length, <PgUp> and <PgDn> keys can be used to view other parts of the directory.



A specified work file has two files associated with it: one is a data file and the other an output file. For an illustration, assume that the work file name specified by you is EXAMPLE. This implies that the program will use EXAMPLE.DAT as the data file and EXAMPLE.OUT as the output file. Given a file name, four different combinations of the .DAT and .OUT file exist depending on which files are present on the current directory and path. The following table describes these for the above work file name and also gives the action taken by the program in each case.

Table 1. Four Possible Combinations of Data and Output Files Associated With a Given Work File Name.

No.	EXAMPLE.DAT on directory	EXAMPLE.OUT on directory	Allowed PASSER III-88 action from MAIN MENU
1	Yes	Yes	E (Edit Data),R,I,O,Q
2	Yes	No	E (Edit Data),R,I,Q
3	No	Yes	O,Q
4	No	No	E (Create Data),Q

NOTE: The Letters (E,R,I,O,Q) given in this column are the first characters of each selection on the MAIN MENU and are pressed to execute the associated action.

The copy and delete actions are executed by pressing the <F2> and <F3> function keys, respectively. The copy function allows a specified file called the SOURCE file to be copied to another file called the TARGET file. The program uses pop-up windows to allow you to specify SOURCE and TARGET file names. The delete key (<F3>) can be used to delete any file. A pop-up window is used to specify the file to be deleted. To protect you from accidental deletions, this option requires you to provide complete specification (Drive:\Path\Filename) of the file to be deleted. The copy and delete actions can be aborted at any time by pressing the <Esc> key. The bottom part of Figure 2 illustrates a case where a data file EXAMPLE.DAT is copied to a file TRAFFIC.DAT. Note that the copy and delete functions may or may not involve the current work file.

## II. CODING INSTRUCTIONS

### Introduction

Data for the microcomputer version of PASSER III-88 are coded using four unique data input screens: Freeway Identification, Interchange and Signal Phasing Data, Interchange Movement Data, and Frontage Road Progression Data. These screens are designed to ensure easy data entry and editing for both new and experienced users. A screen is composed of several data fields, the data entry in some of which are allowed only when related data were entered in a prior field. This dependency will be illustrated in the sections to follow.

The arrow keys are used to move the cursor between the data fields on a screen. The backspace key and spacebar move the cursor within a data field. The <HOME> and <END> keys move the cursor to top left and bottom right positions, respectively. In addition, the <PgUp> and <PgDn> keys let you view and/or edit previous or next interchange data. On the Frontage Road Progression Data Screen, these four keys act slightly differently. This difference is described later when details about that screen are given. These keys are extremely useful in editing an incorrect entry. The <Esc> key allows you to exit the current screen.

The program automatically sets the mode to "data entry" when a new data set name is selected through the File-Data Set choices option or the EDIT option is selected from the MAIN MENU. In the edit mode, the <Esc> key will exit to the edit menu. In the data entry mode, the <Esc> key will exit to the next data entry screen, unless the current screen is the last screen, in which case the <Esc> key terminates the "data entry" mode and takes control back to the MAIN MENU. It should be noted, however, that once a screen is exited, it cannot be reaccessed in the data entry mode. You must go to the EDIT mode if corrections are needed to data on previous screen(s). Each of the data input screens is described in the following sections.

### Freeway Identification

This screen is used to input general data applicable to all interchanges for which data will be entered on subsequent screens. The data entered on this screen can be divided into two categories: problem identification data and data used for problem solving. This screen is illustrated using Figures 3 and 4. Figure 3 is an illustration of the case where data are entered for an isolated interchange, while Figure 4 illustrates the data input for the case where data are entered for multiple interchanges. A description of the data entered on this screen is as follows:

1. **Run Number (2 alphanumeric characters).** Any number from 01 to 99 can be used to identify a particular run in a series of runs made on a freeway. This field may be left blank.



FREWAY IDENTIFICATION

① Run Number: 1 Freeway Name: INTERSTATE HIGHWAY 95 ②  
District : ③ City Name: JACKSONVILLE ④  
Number of Interchanges (1 for isolated analysis) : 1 ⑤  
-----CYCLE LENGTHS-----  
⑥ Lower: 45 Upper: ⑦ 60 Incr: 5 ⑧  
Calculate Band Split Proportional to Traffic?(Y/N): ⑨  
"A" direction Percentage ( 0 to 100 ): ⑩  
Speed Search? (Y/N): ⑪  
  
Time/Space Diagram (Y/N): ⑫  
-----PLOT SCALING / INCH-----  
⑬ Horizontal (Seconds): Vertical (Feet): ⑭  
Note: Set to 0 for program selected values

Escape key to exit screen

Figure 3. Freeway Identification Data Input Screens for Isolated Intersections.

FREWAY IDENTIFICATION

① Run Number: 6 Freeway Name: NORTH CENTRAL EXPRESSWAY ②  
District : 18 ③ City Name: DALLAS ④  
Number of Interchanges (1 for isolated analysis) : 4 ⑤  
-----CYCLE LENGTHS-----  
⑥ Lower: 65 Upper: ⑦ 75 Incr: 5 ⑧  
Calculate Band Split Proportional to Traffic?(Y/N): N ⑨  
"A" direction Percentage ( 0 to 100 ): 50 ⑩  
Speed Search? (Y/N): Y ⑪  
  
Time/Space Diagram (Y/N): Y ⑫  
-----PLOT SCALING / INCH-----  
⑬ Horizontal (Seconds): 0 Vertical (Feet): 0 ⑭  
Note: Set to 0 for program selected values

Escape key to exit screen

Figure 4. Freeway Identification Data Input Screen for Multiple Interchanges.

2. **Freeway Name** (24 alphanumeric characters). This field is used for identification purposes and may be left blank.
3. **District Number** (2 alphanumeric characters). This field is used for identification purposes and may be left blank.
4. **City Name** (12 alphanumeric characters). This field is used for identification purposes and may be left blank.
5. **Number of Interchanges** (2 digits). The number of interchanges coded must be between 1 and 15.
6. **Lower Cycle Length** (3 digits). The smallest cycle length (in seconds) the program may consider in finding a solution. It should be at least as large as the sum of the minimum conflicting greens at either intersection. The smallest permissible cycle length should be calculated beforehand using Poisson, Webster or some other suitable technique. Each side of the interchange may require a different set of minimum conditions. The larger of the two must be coded. The program will not accept a value less than 40 seconds.
7. **Upper Cycle Length** (3 digits). The upper cycle length value that can be coded is constrained by the lower cycle length as a lower limit, a value of 150 seconds for optimization, and 300 seconds for evaluation as the upper limit. The program will execute properly even though the difference between the upper and lower cycle lengths is large. Past experience, however, has shown that a cycle length suitable for all interchanges is picked only if the range is approximately 15 seconds. A methodology for estimating lower and upper cycle lengths for an interchange is given in Appendix C.
8. **Cycle Length Increment** (2 digits). Number of seconds the program should use between the lower and upper cycle length limits. A five-second increment is recommended for pretimed signal system, but a different increment could be used for a digital or analog traffic responsive system.

**Note:** The following points only apply to problems having more than one interchange wherein the signal timing of each is coordinated to provide one-way progression along either or both one-way frontage roads.

9. **Calculate Band Split Proportional to Traffic (Y/N)**. If a "Y" is entered, the bands in the "A" and "B" directions will be split in proportion to the frontage road volume. If an "N" is coded, the value read from field 10 is used.
10. **"A" Direction Percentage** (3 digits). Data entry in this field is allowed only when an "N" is coded in field 9 described above. This field allows you to code a percent of the total progressive bandwidth to be provided in the "A" direction (from interchange 1 to interchange N). If a value of 100 is entered, a one-way progression

solution will be provided in the "A" direction; if a zero is entered, a one-way progression solution will be provided in the "B" direction (from interchange N to interchange 1).

11. **Speed Search (Y/N).** If a "Y" is entered, the program will uniformly add or subtract up to 2 mph on each link to find the maximum bandwidth. If an "N" is coded, the speed will not be allowed to vary from that entered for the entire network.
12. **Time/Space Diagram (Y/N).** If a value of "Y" is entered in this field, a time/space diagram will be produced. If a "Y" is entered, you are allowed to enter values in fields 13 and 14 described below.
13. **Horizontal Scale (2 digits).** Number of seconds to be used on the horizontal scale of the time-space diagram. If a zero or out-of-range value is entered, this value is calculated by the program so that the horizontal axis fits on an 80-column screen.
14. **Vertical Scale (6 digits).** Number of feet to be used on the vertical scale of the time-space diagram. If a zero is entered, this value is calculated by the program so that the horizontal axis fits on an 80-column screen.

#### **Interchange and Signal Phasing Data**

This screen allows you to input a portion of the interchange specific and signal phasing data. A separate set of data is required for each interchange in the network. Figures 5 and 6 illustrate this screen. A description of the data entered on this screen is as follows:

1. **Cross Street Name (12 alphanumeric characters).** This field is used for identification purposes only and may be left blank.
2. **Permitted Left Turn (Y/N).** A "Y" is coded for either side of the interchange (left or right) where a combination of protected and permitted left-turn phasing (circular green with green arrow followed by circular green, or vice versa) is provided for left-turn movements onto the frontage road. If an "N" is coded, permitted (unprotected) left turns will not be considered.
3. **Interior Travel Time (2 digits).** This is the running travel time in seconds from the stop line at the left (right) side intersection to the stop line at the right (left) side intersection and is indicated by the symbol --Rgt--> (<--Lft--). If field data are not available, estimates of the travel time required for a queue of vehicles stopped at one intersection to start up and travel across to the adjacent intersection are given in Table 2 on page 14.

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INTERCHANGE 1 DATA

<p>① Cross Street Name GOLFAIR</p> <p>③ Interior-Travel-Time --Rgt--&gt; &lt;---Lft-- (Sec) (Sec) 21 21</p>	<p>② Permitted Left Turns (Y/N) Left-side: N Right-side: N</p> <p>④ Interior-Queue-Storage Left-Side Right-Side Left Thru Left Thru 6 46 6 46</p>
-----------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------

⑤ SIGNAL PHASING DATA

a) Type of Phasing	b) Run Delay-Offset Analysis (Y/N)	c) Forced Int.	d) Forced Ext.
Lead-Lead	N		
Lag-Lead	N		
Lead-Lag	N		
Lag-Lag	Y		
TTI-Lead	N		

Esc:exit screen      PgUp/PgDn:next interchange

Figure 5. Interchange and Signal Phasing Data Input Screen for Interchange 1.

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INTERCHANGE 4 DATA

<p>① Cross Street Name SOUTHWESTERN</p> <p>③ Interior-Travel-Time --Rgt--&gt; &lt;---Lft-- (Sec) (Sec) 10 10</p>	<p>② Permitted Left Turns (Y/N) Left-side: Y Right-side: Y</p> <p>④ Interior-Queue-Storage Left-Side Right-Side Left Thru Left Thru 3 9 2 10</p>
----------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------

⑤ SIGNAL PHASING DATA

a) Type of Phasing	b) Run Delay-Offset Analysis (Y/N)	c) Forced Int.	d) Forced Ext.
Lead-Lead	N	9	
Lag-Lead	N	35	
Lead-Lag	N	35	
Lag-Lag	N	0	
TTI-Lead	N		

Esc:exit screen      PgUp/PgDn:next interchange

Figure 6. Interchange and Signal Phasing Data Input Screen for Interchanges 2 through 15.

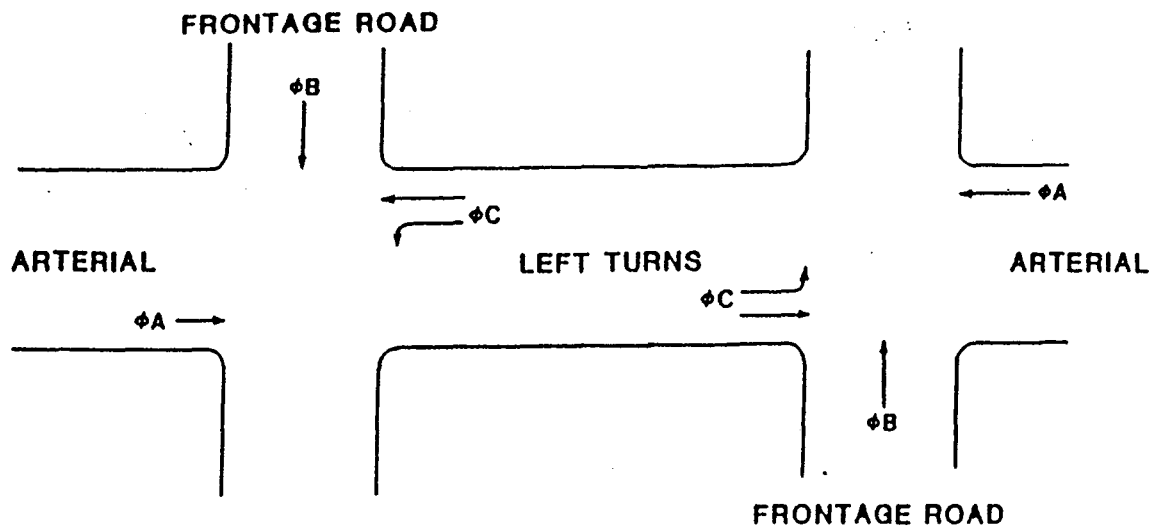
Table 2. Interchange Interior Travel Time and Overlap as a Function of Separation Distance Between Intersection Stop Lines.

Distance(Feet)	Travel Time(seconds)	Overlap(seconds)
67	6	4
94	7	5
125	8	6
160	9	7
200	10	8
244	11	9
288	12	10
332	13	11
376	14	12
420	15	13

NOTE: The overlap is used primarily with the phase code 1A and the travel time is calculated using the following equation: Travel time = SQRT (.45 x distance) + 0.5; 30 mph maximum speed. Some modifications due to grades or heavy truck traffic may be desired.

4. **Interior Queue Storage.** This is the number of vehicles, corresponding to the appropriate movement, which can be stopped within the interchange without impeding crossing traffic on the frontage roads. An estimate of queue storage can be obtained by assuming that one vehicle occupies 25 feet of lane space. Multiple lane storage must be added, and a single lane may share storage between left-turn and through movements.
  
5. **Signal Phasing Data.** This section of the screen is divided into four columnar subsections. The first, labeled "a", is a listing of the five allowable phasing code types, an illustration of which is given in Figure 7. The last three columns are labeled "b", "c", and "d", respectively. They allow you to select and input the desired options corresponding to each phasing code. A "Y" in column "b" means that a delay-offset analysis is desired. Data entry in column "c" is allowed only if the corresponding entry in column "b" is an "N". If a known internal offset is to be evaluated, the offset in seconds is entered in this column. This field is left blank if this phase is not to be considered. Procedures for converting existing pretimed diamond interchange signal timings to the phasing code and internal offset values required by PASSER III-88 are presented in Appendix D.

Data entry in column "d" allows the evaluation of a specific offset between interchange 1 and the current interchange. Data entry in this column, therefore, is not permitted for the first interchange.



PHASING CODE	LEFT SIDE PHASE SEQUENCE			LEFT TURN SEQUENCE	RIGHT SIDE PHASE SEQUENCE		
	A	B	C		A	B	C
1				LEAD-LEAD			
2				LAG-LEAD			
3				LEAD-LAG			
4				LAG-LAG			
1A				TTI-LEAD			

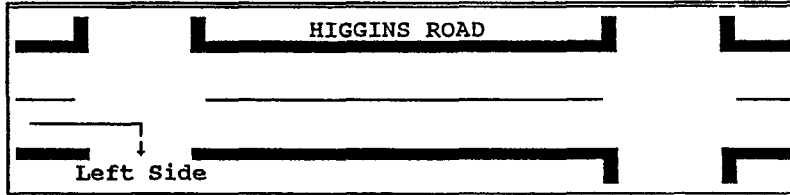
Figure 7. Phasing Code Descriptions Used by PASSER III-88.

## Interchange Movement Data

This screen is used to enter data regarding interchange movements. Volume, saturation flow, and minimum green time data are input for each movement. The top part of this screen shows a diagram of an intersection with an arrow showing the movement corresponding to the current location of the cursor. Figure 8 shows a sample screen. Figure 9 shows all the interior and exterior movements at an interchange; the movement numbers correspond to labels on Figure 8. The cursor keys, previously described, can be used to facilitate data entry on this screen. A separate set of data is entered for each interchange in the network. The description of the data entered on this screen is as follows:

- a. **Volume (Vehicles Per Hour).** This is the passenger car volume in vehicles per hour. Only vehicles impacted by the signalization should be coded. If either a free right-turn lane or U-turn lane exists, those volume fields should be left blank. Adjustments for impedances to through movements and adjustments due to turning speed are discussed in the 1985 Highway Capacity Manual (8).
- b. **Saturation Flow (Vehicle Per Hour Green).** Reasonably accurate values should be established for saturation flow since green times are calculated based on the movement's volume-to-saturation flow ratio. Thus, saturation flow units (e.g., vehicles per hour of effective green) must be the same interval of time as the volume units. The saturation flow rates can be estimated by using the 1985 Highway Capacity Manual (8). Example calculation techniques are illustrated in Appendix E.

An alternative approach to determining the movement's saturation flow is to assume that it is 'N' times the saturation flow for one lane, where 'N' is the number of lanes used by the movement. A partial lane may be used since lanes are shared by signal phases. Approximate saturation flow per lane can be obtained from Table 3 on page 19 (6).



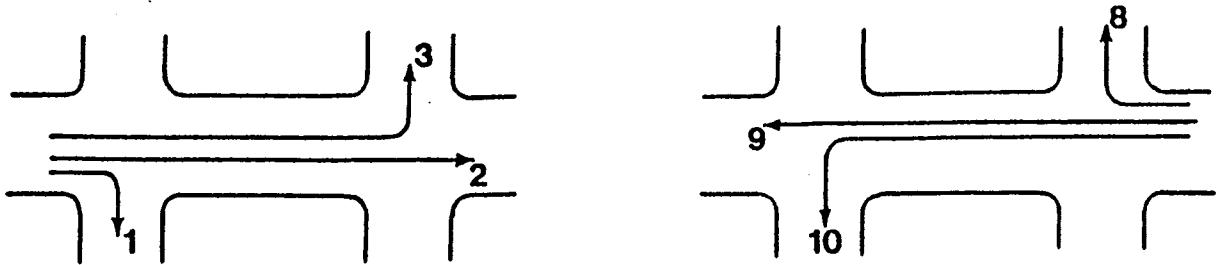
(a) Vol/ Hour	(b) Sat Flow	Min Green	(c)		(a) Vol/ Hour	(b) Sat Flow	Min Green	(c)
564	1700	1		CROSS-STREET	325	1700	8	
844	3621	10	2	right-turn	1053	4743	10	9
346	1479	3		straight-through	78	357	10	
				straight-then-left				
				FRONTAGE ROAD				
780	1700	4		right-turn	192	1700	11	
289	1700	10	5	straight-through	633	2533	10	12
941	2231	6		left-then-straight	618	2247	13	
362	868		7	left-then-left	25	93		14
				INTERIOR				
103	1700	15	10	left-turn	708	3100	17	10
1671	5100	10	16	straight-through	1785	5100	10	18

Esc:exit screen PgUp/PgDn:next interchange

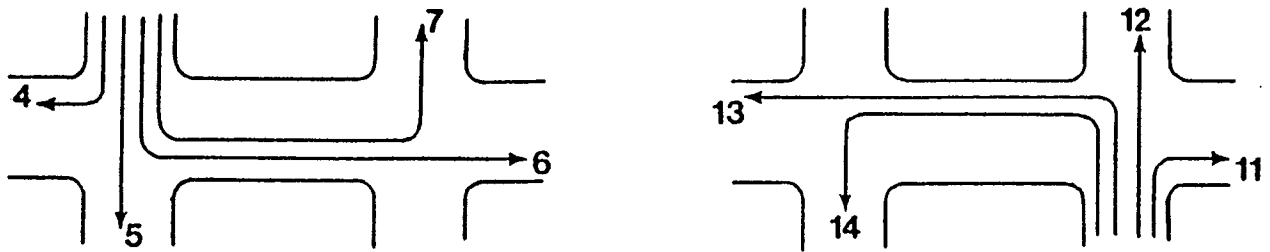
Figure 8. Interchange Movement Data Input Screen.



### CROSS STREET MOVEMENTS



### FRONTAGE ROAD MOVEMENTS



### INTERIOR MOVEMENTS

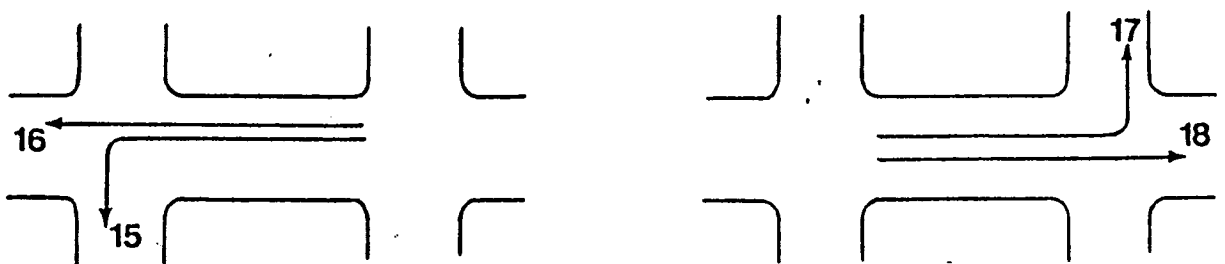


Figure 9. Interchange Movements Required by PASSER III-88.

Table 3. Saturation Flow For Diamond Interchanges in Texas  
(Vehicles per Hour of Green per Lane).

Geometric Conditions	Estimated Saturation Flow Per Hour of Effective Green		
	Protected Left (Single Lane)	Protected Left (Double Lane)	Protected Through (Left Lane Only)
Bay Length Adequate	1700-1770	1600/Lane	1750-1900
Bay Not Adequate	1500	1350/Lane	1650-1770
No Bay	1400	Not recommended	1450-1560

Note: For unprotected left-turn movements, multiply the number of left turns by 1.6 and add to the accompanying through volume. Add the saturation flow of the protected left turn bay to that of the accompanying through movement if it is present.

- c. **Minimum Green (seconds).** The minimum green time in seconds for each critical movement is the minimum time that may be considered for the green, yellow and all-red (red clearance) time, if any, for that approach. For example, if the desired minimum green interval was 10 seconds followed by a 3 second yellow clearance and a 1 second all-red interval, the coded minimum green time would be 14 seconds. The minimum phase times must be long enough to ensure adequate walk and walk clearance time for pedestrians crossing the other street.

It is essential that the sum of minimum green for phase A, B, and C at the left-side intersection (movements 2, 5, and 15) and the sum for phase A, B, and C at the right-side intersection (movements 9, 12, and 17) do not exceed the minimum cycle length requested on the Freeway Identification Screen. An example using the data previously illustrated in Figure 8 follows:

Phase Designation Movement Number Minimum Green Time (G <sub>T</sub> + Y + AR)	Left-Side			Right-Side		
	A	B	C	A	B	C
	2	5	15	9	12	17
	19	30	16	14	30	21
Minimum Green Sums	65			65		
Minimum Cycle Length	65 seconds					

Conclusion: With the above minimum greens coded, the lower cycle length value must equal or exceed 65 seconds.

## Frontage Road Progression Data

The data input on this screen is required only for problems having more than one interchange. If this is the case, it is assumed that you desire to coordinate the signal timings of the adjacent signalized diamond interchanges to provide progression for frontage road traffic between the interchanges, as if the one-way frontage roads formed a divided arterial street. This set of data is used for progression information on frontage roads. Each line of data on this screen pertains to the two links connecting adjacent interchanges. Cross street names provided on the "Interchange Data and Signal Phasing Information" screen described earlier are used to identify each set of links. This screen is illustrated using Figures 10 and 11. Note that when entering data in the "A" direction, the link name is from Houston Avenue to Dallas Avenue and when entering data in the "B" direction, the link name is from Dallas Avenue to Houston Avenue. A description of the data entered on this screen is as follows:

1. This set of information is used to identify the link for which data are being input. The names of cross streets change depending on the location of the cursor.
2. This set of information is used to identify the sets of links for which data input is required. The names of cross streets entered earlier are used in these labels. These names refer to the two ends of a link.
3. This set of data pertains to the links whose direction ("A" direction) is determined by the order in which interchange data were entered. Each of the three data fields will be described in detail as follows. Figure 10 illustrates this case.
  - a. **Distance.** This is the distance in feet from one interchange to the next. Normally, this distance is measured from stopline-to-stopline of the two interchanges.
  - b. **Speed.** This is the desired average running speed in miles per hour for the link whose length was entered in (1) above. The average speed between interchanges should be obtained from a floating car study or other similar method for each period studied by the model. A floating car study is based on the average speed found to exist between two points by traveling within or following platoons of vehicles. The average speed is estimated from five to ten trial runs during the off-peak traffic volume conditions and five to ten trial runs during each peak period condition. The speeds obtained should be free flowing speeds of platoons between stop signs and/or stops at traffic signals. Trial runs during both off-peak and peak periods should be made to determine if different average speeds occur on different links.

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FRONTAGE ROAD PROGRESSION DATA

① Link Name From: HOUSTON AVE To: DALLAS AVE	③ From -----> To ④ To <----- From Dist Speed Que Clr Dist Speed Que Clr a (Ft) b (MPH) c (Sec) a (Ft) b (MPH) c (Sec)
HOUSTON AVE      DALLAS AVE	1900    35      0      1900    35      0
DALLAS AVE      EL PASO ST	2650    30      0      2650    30      0
EL PASO ST      ELGIN BLVD	2220    38      0      2220    38      0

Esc:exit screen      PgUp/PgDn:next link

Figure 10. Frontage Road Progression Data  
Input Screen ("A" Direction).

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FRONTAGE ROAD PROGRESSION DATA

① Link Name From: DALLAS AVE To: HOUSTON AVE	③ From -----> To ④ To <----- From Dist Speed Que Clr Dist Speed Que Clr a (Ft) b (MPH) c (Sec) a (Ft) b (MPH) c (Sec)
HOUSTON AVE      DALLAS AVE	1900    35      0      1900    35      0
DALLAS AVE      EL PASO ST	2650    30      0      2650    30      0
EL PASO ST      ELGIN BLVD	2220    38      0      2220    38      0

Esc:exit screen      PgUp/PgDn:next link

Figure 11. Frontage Road Progression Data  
Input Screen ("B" Direction).

- c. **Queue Clearance Time.** This time given in seconds, allows the vehicles traveling in a progression band to arrive at the downstream signal a specified number of seconds after the start of the green in that direction. The provision is made in order for queued vehicles arriving from a side street or parking lots to clear, thereby allowing the platoon to pass through the interchange without stopping. The program attempts to balance any available slack time, and as a consequence, some queue clearance times may occur even if none have been coded. It is therefore recommended that an initial run be made with zero queue clearance times. A second run can be made by giving queue clearance times based on the results of the initial run, or hand adjustments can be made to the time-space diagram.
4. This section allows distance, speed, and queue clearance data to be entered for the opposing link ("B" direction) corresponding to the link described in item 3. The direction of these links is opposite that of corresponding links in "A" direction. Figure 11 illustrates this case.

### III. OUTPUT INTERPRETATION

#### Introduction

The output file from the microcomputer version of PASSER III-88 is accessed from the **OUTPUT MENU**. As shown in Figure 1 on page 4, this menu provides 12 options for viewing either a portion of or the entire output file. Each option can be individually selected by pressing the first letter of the desired option. Once an option has been selected, you can view additional screens in that portion of the output file by use of the <PgUp> and <PgDn> or the <HOME> and <END> keys. The page number being reviewed and the total number of pages in the selected portion of the output file are shown near the bottom of the screens. You have the additional option of printing individual screens or the entire "subfile" by use of the <F2> and <F3> function keys. The <Esc> key allows you to escape from the portion of the output file being viewed and/or printed and return to the **OUTPUT MENU**. The following sections describe the interpretation of the many different variables output by PASSER III-88. FORTRAN warning and error messages may be printed within the output file generated by the program. Descriptions of these messages are included in Appendix F.

#### General Information

This portion of the output file is selected by pressing the letter "P" (i.e., **Problem-Identification Data**) and contains two screens of information describing the identification parameters and options that were input to the program. The first screen, shown in Figure 12, contains general information that is used for identification purposes only; i.e., it is not used in the program's execution. The specific identification data illustrated on this screen are:

1. **Freeway Name.** The name of the freeway or expressway along which the interchange of interest is located.
2. **City Name.** The name of the city or county in which the interchange of interest is located.
3. **District Number.** The number of the SDHPT district in which the interchange of interest is located.
4. **Date.** The date on which either the data were collected or the program was run. More specifically, it is the date entered/selected by you on the program's title screen. The default is the date in your microcomputer's internal clock.
5. **Run Number.** You assigned an identification number to a particular signalization and/or geometric alternative at the interchange of interest.

<GID01>

TEXAS DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION  
DIAMOND INTERCHANGE SIGNALIZATION - 145105  
PASSER III-88

PASSER3

VER 1.0  
SEPT 88

PPPP	AAA	SSS	SSS	EEEE	RRRR	IIIIIIIIIIII
P P	A A	S S	S S	E	R R	I I I
P P	A A	S	S	E	R R	I I I
PPPP	AAAAA	SSS	SSS	EEEE	RRRR	I I I
P	A A	S	S	E	R R	I I I
P	A A	S S	S S	E	R R	I I I
P	A A	SSS	SSS	EEEE	R R	IIIIIIIIIIII

\*\*\*\*\* GENERAL IDENTIFICATION DATA \*\*\*\*\*

- ① FREEWAY NAME - - - I-290(existing) A.M.PEAK
- ② CITY NAME - - - - - SCHAUMBER
- ③ DISTRICT NUMBER - - - - - 1
- ④ DATE - - - - - 01/04/80
- ⑤ RUN NUMBER - - - - - 7

Figure 12. General Identification Data.

The second screen, shown in Figure 13a or 13b, contains the parameters and options that were input to the program. If an interchange is to be analyzed as isolated (i.e., the number of interchanges equals 1), the second screen will be similar to Figure 13a. If interchanges are to be analyzed as a system (i.e., the number of interchanges is greater than 1), the second screen will be similar to Figure 13b. The specific parameters and options shown on these screens are:

#### **Isolated Operation (Figure 13a)**

1. **Number of Interchanges.** The number of interchanges will equal 1 indicating that the interchange of interest was analyzed as an isolated interchange.
2. **Lower Cycle Limit (Sec).** The shortest cycle length that was analyzed.
3. **Upper Cycle Limit (Sec).** The longest cycle length that was analyzed.
4. **Cycle Increment (Sec).** Defines the increment size for the intermediate cycle lengths that were analyzed between the lower and upper cycle limits.
5. **Optimize Internal Offsets?** Indicates whether or not the offset(s) between the two signals at the interchange was optimized.
6. **Evaluate Internal Offset?** Indicates whether or not a specific offset(s) between the two signals at the interchange of interest was evaluated.

#### **Interconnected Operation (Figure 13b)**

7. **Number of Interchanges.** The number of interchanges will be between 2 and 15 indicating the interchanges of interest were analyzed as a progressive system.
8. **Min. "A" Direction Band (%).** Indicates whether or not the total bandwidth along both frontage roads was split in proportion to the proportion of the through traffic in each direction. If a proportional split was not requested, the "A" direction percentage will reflect the desire percentage that was input to the program.
9. **Optimize Internal Offsets?** Indicates whether or not the offset(s) between the two signals of at least one of the interchanges was evaluated.
10. **Evaluate Internal Offset?** Indicates whether or not a specific offset between the two signals of at least one of the interchanges was optimized.



```

<GID02>
***** ISOLATED INTERCHANGE OPERATION *****
*** PARAMETERS ***
  ① NUMBER OF INTERCHANGES - - - - 1
  ② LOWER CYCLE LIMIT (SEC) - - - - 90
  ③ UPPER CYCLE LIMIT (SEC) - - - - 90
  ④ CYCLE INCREMENT (SEC) - - - - 0
*** OPTIONS ***
  ⑤ OPTIMIZE INTERNAL OFFSETS ? - - YES
  ⑥ EVALUATE INTERNAL OFFSETS ? - - NO

```

Figure 13a. Parameters and Options for Isolated Interchanges.

```

<GID02>
***** FRONTAGE ROAD PROGRESSION INFORMATION *****
*** PARAMETERS ***
  ⑦ NUMBER OF INTERCHANGES - - - - - 4
    LOWER CYCLE LIMIT (SEC) - - - - - 65
    UPPER CYCLE LIMIT (SEC) - - - - - 75
    CYCLE INCREMENT (SEC) - - - - - 5
  ⑧ MIN. ' A ' DIRECTION BAND SPLIT (%) - 50
*** OPTIONS ***
  ⑨ OPTIMIZE INTERNAL OFFSETS ? - - - - YES
  ⑩ EVALUATE INTERNAL OFFSETS ? - - - - YES
  ⑪ VARY LINK SPEEDS ? - - - - - YES
  ⑫ EVALUATE EXTERNAL OFFSETS ? - - - - NO

```

Figure 13b. Parameters and Options for Frontage Road Progression.

11. **Vary Link Speeds?** Indicates whether or not the speed along the frontage roads was varied in an attempt to further maximize bandwidth.
12. **Evaluate External Offsets?** Indicates whether or not at least one existing offset between the intersections was evaluated.

### Traffic Movement Information

This portion of the output file is selected by pressing the letter "M" (i.e., **Movement-Interchange Data**) and contains two screens of information for each interchange that was analyzed by this run of the program. These data were input by you. The first screen, shown at the top of Figure 14, contains the volumes, saturation flows, and minimum greens for each of the movements at the left-side intersection of the interchange. The second screen, shown at the bottom of Figure 14, contains the same information for each of the movements at the right-side intersection of the interchange. The identification number and name of the interchange, along with the identification number for this particular alternative analysis, are shown on the top line of each screen. The specific data illustrated on each screen are:

1. **Traffic Movement.** The nine individual traffic movements at the intersection (See Figure 8, Page 17).
2. **Volume (VPH).** The hourly volume input for each of the nine individual traffic movements at the intersection.
3. **Saturation Flow (VPHG).** The hourly saturation flow rates input for each of the nine individual movements at the intersection.
4. **Minimum Phase (Sec).** The minimum phase times input for the three basic phases at the intersection. These times include the length of the clearance intervals.

### Internal Delay Offset Information

This portion of the output file is selected by pressing the letter "I" (i.e., **Interchange-Phasing Data**) and contains one screen of information for each interchange that was analyzed by this run of the program. The interchange data were input to the program by you. As shown in Figure 15, the identification number and name of the interchange, along with the identification number for this particular alternative analysis are shown on the top line of each screen. The specific data illustrated on this screen are:

1. **Phasing.** The five allowable phasing schemes at an interchange, an illustration of which is given in Figure 7, Page 15.

```

<IMD01A>
*** INTERCHANGE 1 HIGGINS ROAD                                RUN 7 PAGE 2A

*** LEFT-SIDE MOVEMENT DATA ***

*****
TRAFFIC MOVEMENT          VOLUME          SATURATION          MINIMUM
                           (VPH)           FLOW (VPHG)        PHASE (SEC)
*****
ARTERIAL ①                ②                ③                ④
RIGHT-TURN                564              1700              -
STRAIGHT-THROUGH         844              3621              10
STRAIGHT-THEN-LEFT       346              1479              -

FRONTAGE ROAD
RIGHT-TURN                780              1700              -
STRAIGHT-THROUGH         289              1700              10
LEFT-THEN-STRAIGHT       941              2231              -
LEFT-THEN-LEFT           362              868              -

INTERIOR
LEFT-TURN                 103              1700              10
STRAIGHT-THROUGH         1671             5100              10

```

```

<IMD01B>
*** INTERCHANGE 1 HIGGINS ROAD                                RUN 7 PAGE 2B

*** RIGHT-SIDE MOVEMENT DATA ***

*****
TRAFFIC MOVEMENT          VOLUME          SATURATION          MINIMUM
                           (VPH)           FLOW (VPHG)        PHASE (SEC)
*****
ARTERIAL ①                ②                ③                ④
RIGHT-TURN                325              1700              -
STRAIGHT-THROUGH         1053             4743              10
STRAIGHT-THEN-LEFT       78               357               -

FRONTAGE ROAD
RIGHT-TURN                192              1700              -
STRAIGHT-THROUGH         633              2533              10
LEFT-THEN-STRAIGHT       618              2247              -
LEFT-THEN-LEFT           25               93               -

INTERIOR
LEFT-TURN                 708              3100              10
STRAIGHT-THROUGH         1785             5100              10

```

Figure 14. Traffic Movement Information for the Left- and Right-Side Intersections.

```

<DOI01>
* * * INTERCHANGE 1 GOLFAIR                                RUN 10 PAGE 3
*** INTERNAL DELAY-OFFSET INFORMATION ***
* * * * *
(1) PHASING (2) OPTIMIZE? FORCE? (3) INTERIOR QUEUE STORAGE (4)
* * * * *
LEAD-LEAD          N          -   THROUGH MOVEMENT AT LEFT SIDE (VEH)  46
LAG -LEAD          N          -   LEFT-TURN MOVEMENT AT LEFT SIDE (VEH)  6
LEAD-LAG          N          -   THROUGH MOVEMENT AT RIGHT SIDE (VEH) 46
LAG -LAG          Y          -   LEFT-TURN MOVEMENT AT RIGHT SIDE (VEH)  6
TTI -LEAD         N          -
* * * * *
PERMITTED LEFT TURNS? (5) INTERIOR TRAVEL TIMES (6)
* * * * *
LEFT-SIDE INTERSECTION  NO      LEFT TO RIGHT (SEC)  - - - - - 21
RIGHT-SIDE INTERSECTION NO      RIGHT TO LEFT (SEC)  - - - - - 21

```

Figure 15. Internal Delay-Offset Information.

2. **Optimize?** An "N" indicates that a delay-offset analysis was not conducted for that particular phasing code, whereas a "Y" indicates that a delay-offset analysis was conducted.
3. **Force?** A "-" indicates that a delay offset analysis for a specific offset was not conducted for that particular phasing code. Whereas a "numeric value" indicates that a delay-offset analysis for a specific offset was conducted.
4. **Interior Queue Storage.** For each of the four interior movements, the number of vehicles which can be stopped inside the interchange without impeding traffic flow along the frontage roads.
5. **Permitted Left Turns?** A "Yes" indicates that the effects of left turners filtering through available gaps in the opposing traffic stream were considered in the delay-offset analysis for that particular intersection of the interchange. A "No" indicates that these effects were not considered.
6. **Interior Travel Time.** The travel times provided by you and utilized in the delay-offset analysis that was conducted.

### **Link Geometry**

This portion of the output file is selected by pressing the letter "L" (i.e., **Link-Geometry Data**) and contains one screen of information if, and only if, the interchanges were analyzed as a system (i.e., the number of interchanges was greater than one); otherwise it will be blank. As shown in Figure 16, the identification number for this particular alternative analysis is shown on the top line of each screen. The specific data items illustrated on this screen are:

1. **Link Name.** These names were input by you and represent the upstream and downstream interchanges of the frontage road links.
2. **Distance (ft).** The numbers in these two columns represent the distances in feet between the upstream and downstream interchanges in the "A" and "B" directions.
3. **Speed (mph).** The numbers in these two columns represent the desired progression speed in miles per hour between the upstream and downstream interchanges in the "A" and "B" directions.
4. **Queue Clearance.** The numbers in these two columns represent the minimum length in seconds of thru green that will be provided prior to the platoon's arrival.

```

<LGI01>
*** LINK GEOMETRY *** RUN 2 PAGE 10
*****
'A' DIRECTION 'B' DIRECTION
LINK FRONTAGE ROAD FRONTAGE ROAD
NAME DISTANCE SPEED QUEUE DISTANCE SPEED QUEUE
(FT) (MPH) CLEARANCE (FT) (MPH) CLEARANCE
*****
      ①          ②    ③    ④          ②    ③    ④
HOUSTON AVE TO DALLAS AVE 1900 35 0 1900 35 0
DALLAS AVE TO EL PASO ST 2650 30 0 2650 30 0
EL PASO ST TO ELGIN BLVD 2220 38 0 2220 38 0

```

Figure 16. Link Geometry.

## Delay-Offset Diagrams

This portion of the output file is selected by pressing the letter "D" (i.e., **Delay-Offset Diagrams**) and contains a screen(s) of information for each delay-offset analysis that was conducted. For example, if you requested that at an interchange, one phasing code be optimized for a single cycle length, one screen of information would be created; however, if you then requested that at the same interchange, all five phasing codes be optimized over a range of three different cycle lengths, 15 screens of information would be created. As shown in Figure 17, the interchange number, cross-street name, type of phasing, and cycle length are shown on the top line of each screen, and the internal offset which produces the least delay at the interchange is shown on the bottom line.

Between these two lines of descriptions is a scaled plot of the delay-difference of offset relationship for the traffic, geometric, and signal timing data input to the program. The internal offset (i.e., difference in time between the start of the arterial phase at the left-side intersection and the end of the frontage road phase at the right-side intersection of the interchange) increases from left to right and is shown along the horizontal axis. The total delay experienced by all vehicles using the interchange in an hour is shown on the vertical axis and increases from bottom to top. The "\*\*\*\*" represents the estimated total delay for each of the possible offsets between the two signals at the interchange.

## Optimal Progression Solution

This portion of the output file is selected by pressing the letter "O" (i.e., **Optimal-Progression Solution**) and contains one screen of information, if, and only if, the interchanges were analyzed as a system (i.e., the number of interchanges was greater than one); otherwise, it will be blank. As shown in Figure 18, the identification number for this particular alternative analysis is shown on the top line of the screen, and the freeway or system name is shown on the second line. The specific items of information illustrated on this screen are listed below:

1. **Cycle Length (sec).** This number represents the cycle length in seconds that resulted in the optimal progression solution for this particular system.
2. **Progression Speed (mph).** This value represents the average speed, in miles per hour, of the optimal progression solution. Speeds between links and by direction may vary depending on the input data.
3. **Bandwidth (sec).** This value represents the width of the band, in seconds, of the optimal progression solution. The widths of the bands are constant in the same direction, but may vary by direction.

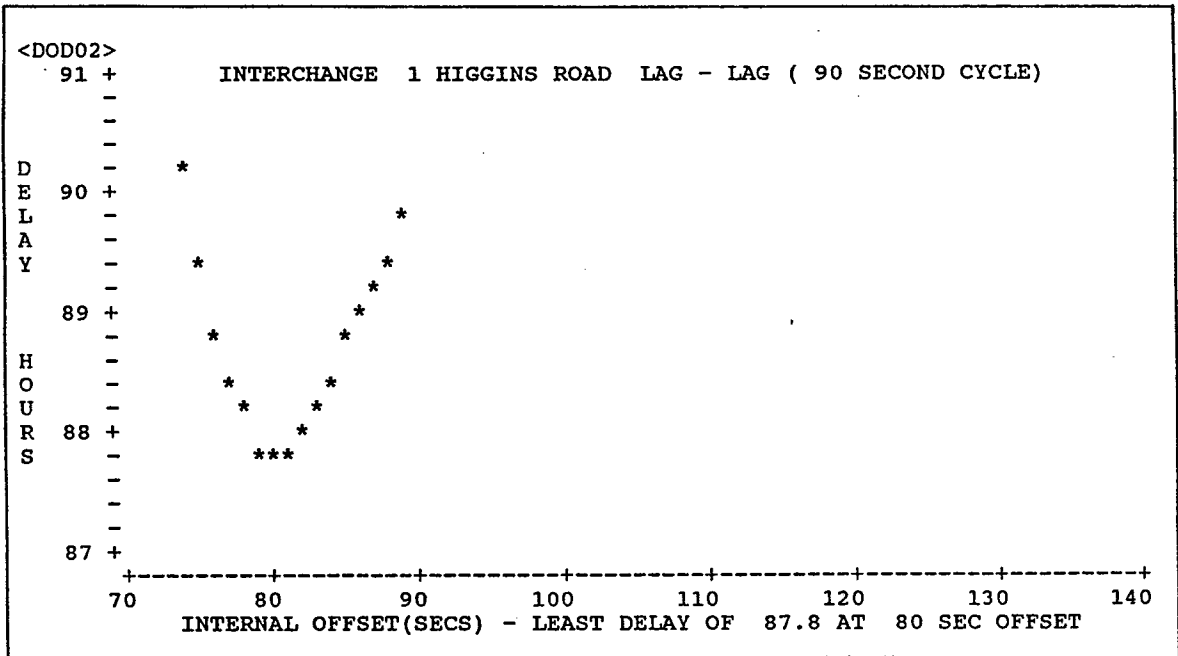
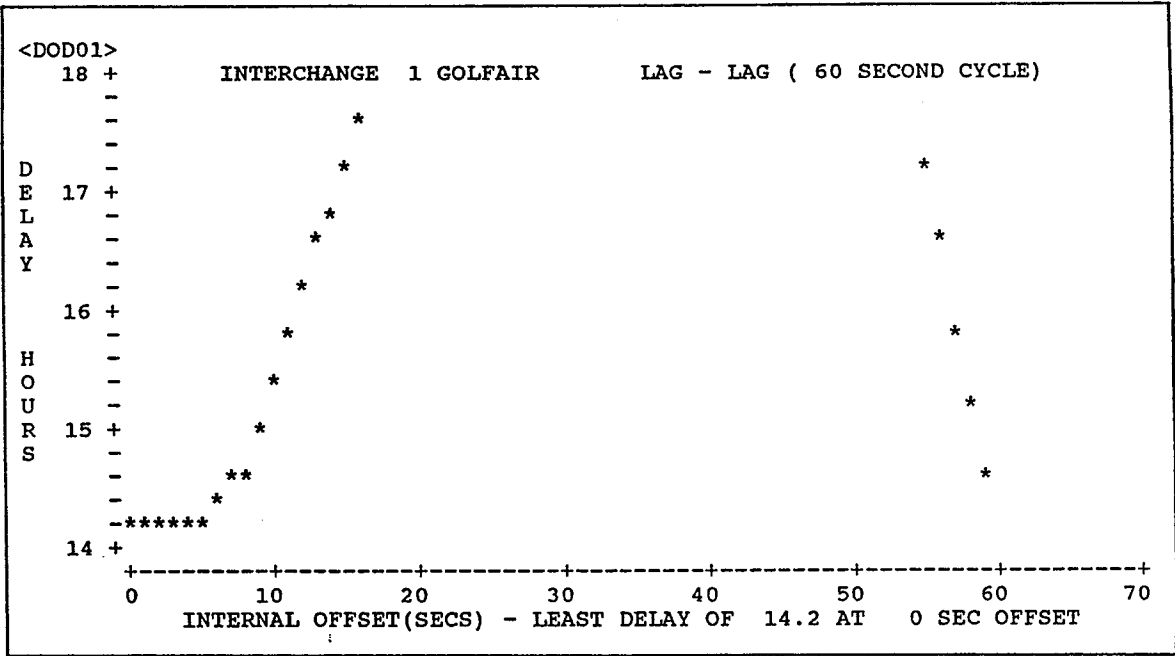


Figure 17. Delay-Difference of Offset Diagrams.



```

<OPS01>
*** OPTIMAL PROGRESSION SOLUTION *** RUN 2 PAGE 11A
      USERS MANUAL EXAMPLE 2
*****
      ① CYCLE LENGTH (SEC) - - - - - 65
      'A' DIRECTION
      ② PROGRESSION SPEED (MPH) - - 33.7
      ③ BANDWIDTH (SEC) - - - - - 24.2
      'B' DIRECTION
      ② PROGRESSION SPEED (MPH) - - 33.7
      ③ BANDWIDTH (SEC) - - - - - 24.2
      ④ EFFICIENCY - - - - - .37
      ⑤ ATTAINABILITY - - - - - .82

```

Figure 18. Optimal Progression Solution.

4. **Efficiency.** This system measure of effectiveness (MOE) represents the average fraction of the cycle length used for progression. It is calculated by summing the widths of the two bands and dividing by twice the cycle length. For frontage roads, efficiencies between 0.2 and 0.4 are indicative of a relatively good progression, whereas efficiencies less than 0.2 are indicative of relatively poor progression.
5. **Attainability.** This system MOE represents the average fraction of the minimum frontage road greens in each direction that are in the progression bands. It is calculated by summing the widths of the two bands and dividing by the sum of the smallest green in each direction. Attainabilities can range from 0.0 to 1.0 with values greater than 0.8 being indicative of a relatively good solution.

#### **Frontage Road Progression Information**

The portion of the output file selected by pressing the letter "F" (i.e., **Frontage Road-Progression Information**) contains one screen of information if, and only if, the interchanges were analyzed as a system (i.e., the number of interchanges was greater than one); otherwise, the screen will be blank. As shown in Figure 19, the identification number for this particular alternative analysis is shown on the top line of the screen, and the freeway or system name is shown on the second line. The specific items of information illustrated on this screen are listed below:

1. **Interchange Cross Street Name.** These names were input by you and represent the cross streets at each signalized interchange in the system.
2. **Signal Phasing Sequence.** These labels represent the sequences of the three basic phases at the left- and right-side intersections at each interchange in the system. These sequences were selected as the "best" for progression.
3. **Internal Offset (sec).** These offsets, in seconds, represent the difference in time between the start of the arterial phase at the left-side intersection and the end of the frontage road phase at the right-side intersection at each interchange in the system. These internal offsets were selected for the optimal progression solution.
4. **External Offset (sec).** These offsets, in seconds, represent the difference in time between the start of the arterial phase at the left-side intersection of the first interchange in the "A" direction and the start of the arterial phase at the left-side intersection of the other interchanges. These external offsets were selected as the "best" for progression.

```

<FRP01>
*** FRONTAGE ROAD PROGRESSION INFORMATION *** RUN 2 PAGE 11B
      USERS MANUAL EXAMPLE 2
*****
INTERCHANGE SIGNAL INTERNAL EXTERNAL 'A' DIRECTION 'B' DIRECTION
CROSS STREET PHASING OFFSET OFFSET TRAVEL TIME TRAVEL TIME
NAME SEQUENCE (SEC) (SEC) (SEC) (SEC)
*****
  (1)      (2)      (3)      (4)      (5)      (5)
HOUSTON AVE LAG -LAG 62 .0 8.2 175.3
DALLAS AVE LAG -LAG 64 23.2 49.7 132.8
EL PASO ST LEAD-LAG 49 38.2 117.3 58.7
ELGIN BLVD LAG -LAG 62 56.2 160.2 14.5

```

Figure 19. Frontage Road Progression Information.

5. "A" and "B" Direction Travel Times. The times in seconds represent the average total travel times for a vehicle to arrive at the stopbar and depart from each interchange in that direction. As such, they include both delay and running time, and the corresponding average speed will be less than the progression speed.

### General Signalization Information

This portion of the output file is selected by pressing the letter "G" (i.e., General-Signalization Information) and contains one screen of information for each interchange that was analyzed by this run of the program; however, if an interchange was analyzed as isolated (i.e., the number of interchanges equals 1), there will be one screen of information for each cycle length that was analyzed. Each screen represents output from the program in the form of signal timings and corresponding measures of effectiveness. As shown in Figure 20, the identification number and name of the interchange, along with the identification number for this particular alternative analysis are shown on the top line of each screen. The specific information illustrated on this screen are listed below:

1. **Phase Time (Sec).** The phase times are calculated, in seconds, for the three basic phases (i.e., arterial, frontage road, and left turn) at each intersection of the interchange. In addition, the phase times during which the interior through movements are moving (i.e., arterial plus left turn) are shown in the columns labeled "A+C." Note that these times include the length of the clearance interval for their respective phases. Although not shown on the screen, the cycle length that was analyzed can be determined by adding the phase times in the columns labeled "B" and "A+C" at either the left- or right-side intersections.
2. **V/c Ratios.** The demand volume-to-signal-capacity ratios are computed for the critical movement (e.g., right turn, through, or left turn) during each phase at each intersection of the interchange. Variables used in this MOE's calculation are volumes, saturation flow rates, cycle lengths, and green splits. The equation used by the program is shown in Appendix C.
3. **Delay.** The average total delay in seconds per vehicle is calculated for the critical movement (e.g., right turn, through, or left turn) during each phase at each intersection of the interchange. Variables used in this MOE's calculation are the same as those used in the calculation of the v/c ratios. The equation that is used by the program is shown in Appendix C.

<GSI01>

\*\*\* INTERCHANGE 1 GOLFAIR

RUN 10 PAGE 7A

\*\*\* GENERAL SIGNALIZATION INFORMATION \*\*\*

```

*****
MEASURES OF          LEFT-SIDE INTERSECTION *   RIGHT-SIDE INTERSECTION
EFFECTIVENESS        A      B      C      A+C *   A      B      C      A+C
*****
①
PHASE TIME (SEC)     17.3   15.0   27.7   45.0 *   22.2   27.8   10.0   32.2
*
V/C RATIO ②          .53    .37    .53    .43 *   .85    .69    .22    .24
LEVEL OF SERVICE ⑧ A      A      A      A      *   D      B      A      A
*
③
DELAY (SEC/VEH)     26.97  24.10   .00    1.76 *   33.04  17.72   7.75   4.75
LEVEL OF SERVICE ⑧ C      C      A      A      *   D      B      B      A
*
④
STORAGE RATIO
LEVEL OF SERVICE ⑧          .00    .07 *           .06    .03
*
A      B      *           B      A
*****
PHASE ORDER ⑤ LAG -LAG      TOTAL INTERCHANGE DELAY ⑦ 14.16 VEH-HRS/HR
INTERNAL OFFSET ⑥ 0 SEC

```

Figure 20. General Signalization Information.

4. **Storage Ratios.** This is the ratio between the calculated maximum expected queue for an average cycle and the available space for queue storage that was input to the program. This MOE is computed for the interior movements at each intersection of the interchange; however, it is not computed for any of the exterior movements at the interchange. The equation that is used by the program is shown in Appendix C.
5. **Phase Order.** This description along with the internal offset and green splits describes the timing plan that has been evaluated as shown on this screen. The term phase order itself refers to the sequence of the three basic phases at the left- and right-side intersections of the interchange.
6. **Internal Offset.** This descriptor along with phase order and green splits describes the timing plan that has been evaluated as shown on this screen. Internal offset itself is a reference for the delay-offset analysis and is defined as the difference in time between the start of the arterial phase at the left-side of the interchange and the end of the frontage road phase at the right-side intersection of the interchange.
7. **Total Interchange Delay.** This MOE reflects the total delay experienced by all vehicles using the interchange in an hour. It is calculated by adding the products of the average delay for each of the 18 movements multiplied by their hourly volumes and dividing the sum by 3600.
8. **Level-of-Service.** These descriptors give the program user an indication of how well the interchange is likely to operate. Therefore, they should be visually examined to ensure that the estimated level-of-service for each measure of effectiveness is acceptable to you. The criteria for level-of-service that is used by PASSER III-88 is shown in Table 4.

Table 4. Level-of-Service Criteria for Operational Measures of Effectiveness at Signalized Diamond Interchanges.

Measures of Effectiveness	Level-of-Service					
	A	B	C	D	E	F
Volume to Capacity Ratio <sup>a</sup>	<.60	<.70	<.80	<.85	<1.0	>1.0
Average Vehicular Delay <sup>b</sup>	<6.5	<19.5	<32.5	<52.0	<78.0	>78.0
Interior Storage Ratio <sup>c</sup>	<.05	<.10	<.30	<.50	<.80	>.80

<sup>a</sup>Source: Guide for Designing and Operating Signalized Intersections in Texas.

<sup>b</sup>Source: Highway Capacity Manual - 1985 (7); however, the criteria in the Manual have been multiplied by 1.3 so as to convert from "stopped" to "total" delay values.

<sup>c</sup>Source: PASSER III-84 User's Manual (6).

**NOTE:** PASSER III-88 by itself cannot guarantee a solution that is suitable for field implementation. Such a discussion is your responsibility, not the program's. In other words, PASSER III-88 selects the best timing plan from the set of alternative timing plans evaluated by the program (i.e., input by you), even if the "best" is only the best of the set of "bad" alternatives.

### Signal Phasing Information

This portion of the output file is selected by pressing the letter "S" (i.e., Signal-Phasing Information) and contains one screen of information for each interchange that was analyzed by this run of the program; however, if the interchange was analyzed as isolated (i.e., the number of interchanges equals 1), there will be one screen of information for each cycle length that was analyzed. Each screen represents output from the program in the form of the signal timing plan that was evaluated by the program. As shown in Figure 21, the identification number for this particular alternative analysis is shown on the top line of each screen. The specific information illustrated on this screen are listed below:

1. **Phase Interval Number.** The numbers in this column represent the intervals of time during which there is no change in the status of the signals at either intersection of the change. Dependent on the internal offsets and the green splits, there can be as few as three and as many as six intervals in signal timing plans that are evaluated.

```

<SPI01>
*** INTERCHANGE 2 DALLAS AVE
RUN 2 PAGE 13B

*** SIGNAL PHASING INFORMATION ***

*****
*          ②           *          ②           *
* LEFT-SIDE SEQUENCE * RIGHT-SIDE SEQUENCE *
*   A     C     B     *   A     C     B     *
① PHASE INTERVAL <--- <--- | <--- ^ | PHASE INTERVAL ③
  NUMBER        <---> | <---> <---> | <---> LENGTH (SEC)
*          V     V     *          |     *
*****
      1      *      A      *      A      *      11.00
      2      *      A      *      C      *      13.00
      3      *      C      *      C      *      11.00
      4      *      B      *      B      *      29.00
      5      *      B      *      A      *      1.00
*****
INTERNAL OFFSET ④ 64 SEC              CYCLE LENGTH ⑥ 65 SEC
EXTERNAL OFFSET 23.2 SEC ⑤           PHASE ORDER LAG -LAG ⑦

```

Figure 21. Signal Phasing Information.



2. **Left- and Right-Side Sequence.** The letters and arrows in the blocks at the top of the two columns represent the sequence occurrence for the three basic phases at each of the intersections. The letters in the blocks at the bottom of the two columns indicate the movement at each of the intersections that has a green indication during that interval of time.
3. **Phase Interval Length (Sec).** The numbers in this column represent the length in seconds of the intervals of time during which there is no change in the status of the signals at either intersection of the interchange. These times include the length of a clearance interval for at least one of the intersections.
4. **Internal Offset.** This descriptor along with the phase order and green splits describes the signal timing plan that has been visually depicted on this screen. Internal offset itself is a reference for the delay-offset analysis and is defined as the difference in time between the start of the arterial phase (Phase A) at the left-side intersection of the interchange and the end of the frontage road phase (Phase B) at the right-side intersection of the interchange.
5. **External Offset.** External offset, in seconds, represents the difference in time between the start of the arterial phase at the left-side intersection of the first interchange in the "A" direction and the start of the arterial phase at the left-side intersection of the other interchanges. These external offsets were selected as the "best" for progression and will be printed, if and only if, the interchanges were analyzed as a system.
6. **Cycle Length.** This number represents the total length of the individual intervals for the signal timing plan that has been visually depicted on this screen. Both intersections operate at this cycle length.
7. **Phase Order.** This descriptor along with the internal offset and green splits describes the signal timing plan that has been visually depicted on this screen. The term order itself refers to the sequence of occurrence for the three basic phases at the left- and right-side intersections of the interchange.

### **Time-Space Diagram**

This portion of the output file is selected by pressing the letter "T" (i.e., **Time-Space Diagram**) and contains one or more screens of information if, and only if, the interchanges were analyzed as a system (i.e., the number of interchanges was greater than one); otherwise, it will be blank. As shown in Figure 22, the city name, district, run number, and horizontal scale are listed on the first line of this file, and the freeway name, cycle length and vertical scale are listed on the second line. Additionally, the "A" and "B" directions' average progression speeds and bandwidths are listed on the last two lines of the file.

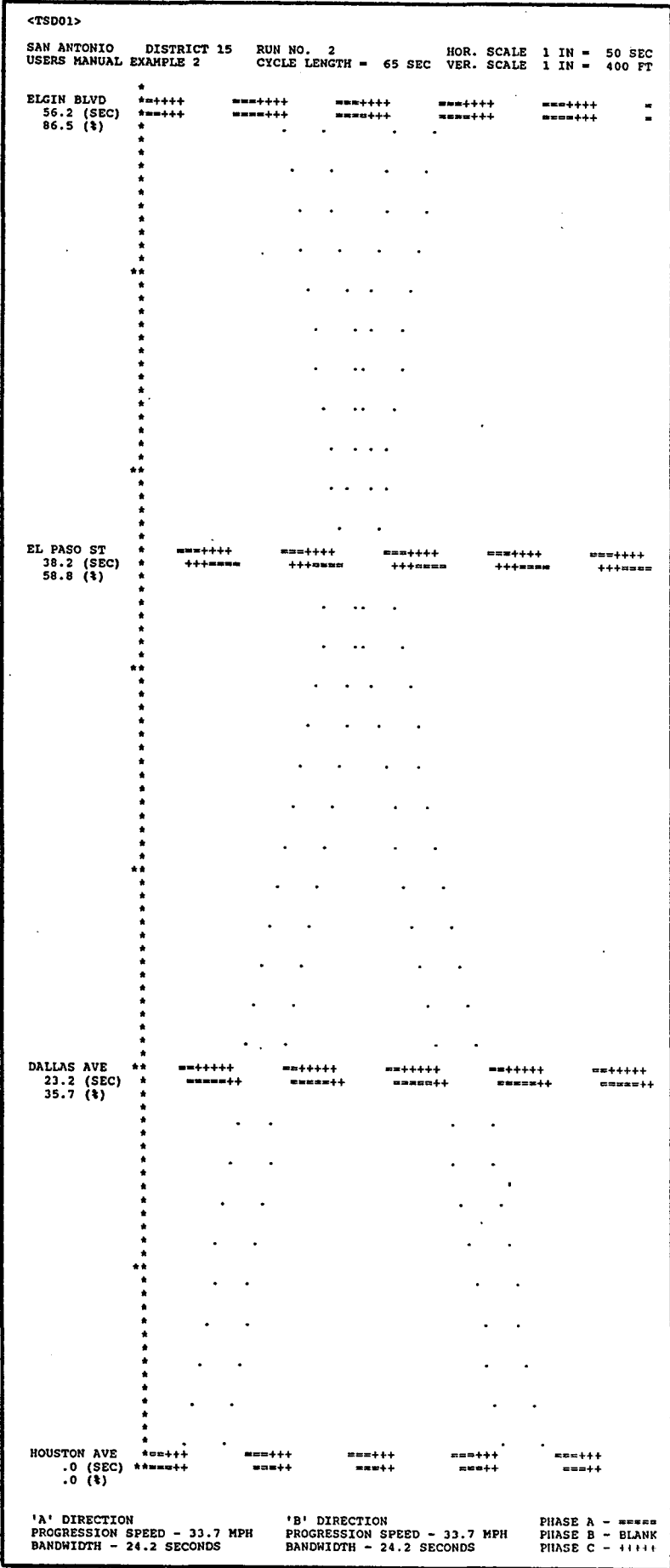


Figure 22. Time-Space Diagram.

Between these two blocks of descriptions is a scaled plot of the time-space diagram for the optimal progression solution. Time increases from left to right and is shown along the horizontal axis. Space or distance increases from bottom to top and is shown on the vertical axis. Interchange locations and external offsets, in both seconds and percent of cycle, are also shown on the vertical axis.

At each interchange, the status of the traffic signal at the left-side intersection is illustrated on the bottom horizontal line, and the status of the traffic signal at the right-side intersection is illustrated on the top horizontal line. The status of the signals at each of the interchanges is indicated by the symbols on the two lines: "====" indicates that the intersection's arterial movements have a green; "(blanks)" indicate that the intersection's frontage road movements have a green; and "++++" indicates that the intersection's left-turn movements have a green. Thus, the progression bands (i.e., the dotted lines) should go through the blanks in the bottom line for the "A" direction (i.e., vehicles traveling from lower left to upper right on the screen) and through the blanks in the top line for the "B" direction (i.e., vehicles traveling from upper left to lower right on the page).



## IV. EXAMPLE PROBLEMS

### Introduction

To assist you in the use of the microcomputer version of the program, two example problems, one isolated interchange and one frontage road progressive system, are included in this section of the manual. In addition, both examples include completed input screens and program output so that you can verify that the program has been correctly installed on your microcomputer. Diagrams of the geometrics, turning movements, and/or signal timing are not included in this report; however, as described in the following sections, much of this information can be ascertained from the data input screens.

### Example 1: Isolated Interchange

Once the MAIN MENU has appeared on the screen, you should press the letter "F" (File-Data Set Options) and change the workfile name from "EXAMPLE" to "TEST01." You should then press the Enter key to enter the workfile name, the <Esc> key to return to the MAIN MENU, the letter "E" (Edit-Define or Modify Data), and enter the data exactly as shown in the General-Freeway Identification, Signal-Phasing Data, and Movement-Interchange Data screens on the following pages. Forward transfer between screens is accomplished by pressing the <Esc> key which will also automatically return you to the MAIN MENU at the completion of data entry. You can then either edit the data, if corrections are needed, or run the program by pressing the letter "R" (Run-PASSER III-88). If the data were entered exactly as shown, the output file shown on the following pages can be either viewed and/or printed from the OUTPUT MENU.

This example is an evaluation of existing conditions at the interchange, where type of phasing (TTI-Lead) and the internal offset (12 seconds) are inputs. Several observations can be made concerning the input data for this problem. First, the sum of the conflicting minimum greens (80 seconds) is much larger than that required for pedestrian considerations. Second, the relatively low saturation flow rates for the interior left-turns suggest the presence of shared rather than exclusive turning lanes. Finally, there is little space for storing interior left-turning vehicles, especially at the right-side intersection.

The output from this problem is not as easy to interpret; however, note that there is an apparent problem with storage of left-turning vehicles at the right-side intersection. The high storage ratio reported indicates that the shared lane is blocked by vehicles waiting to turn left and that combination of the two movements in the same lane may be blocking the upstream in intersection, i.e., gridlock. Thus, operations at the interchange may be worse than depicted in the printout. Delays and volume-to-capacity ratios are near the limit of acceptability and could possibly be improved by geometric and/or operational changes at the interchange.

P A S S E R III - 88  
Texas Department of Highways & Public Transportation

Version 1.0

W E L C O M E TO

```
PPPPPPPP      AAA      SSSSSSS      SSSSSSS      EEEEEEEE      RRRRRRR
PP   PP      AA AA      SS          SS          EE          RR   RR
PPPPPPPP      AAAAAAA      SSSSSSS      SSSSSSS      EEEEEEE      RRRRRRR
PP      AA      AA      SS          SS          EE          RR   RR
PP      AA      AA      SSSSSSS      SSSSSSS      EEEEEEEE      RR   RR
```

```
IIII IIII IIII      8888      8888
II   II   II      88 88 88 88
II   II   II ===      8888      8888
II   II   II      88 88 88 88
IIII IIII IIII      8888      8888
```

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Is September 15, 1988 the correct date (Y/N)?

Y

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FREEWAY IDENTIFICATION

Run Number: 01 Freeway Name: USERS MANUAL EXAMPLE 1  
District : 15 City Name: SAN ANTONIO  
Number of Interchanges (1 for isolated analysis) : 1

-----CYCLE LENGTHS-----  
Lower:100 Upper: 100 Incr: █

Calculate Band Split Proportional to Traffic?(Y/N): █  
"A" direction Percentage ( 0 to 100 ): █  
Speed Search? (Y/N): █

Time/Space Diagram (Y/N): █  
-----PLOT SCALING / INCH-----  
Horizontal (Seconds): █ Vertical (Feet): █  
Note: Set to 0 for program selected values

█ Escape key to exit screen █

INTERCHANGE 1 DATA

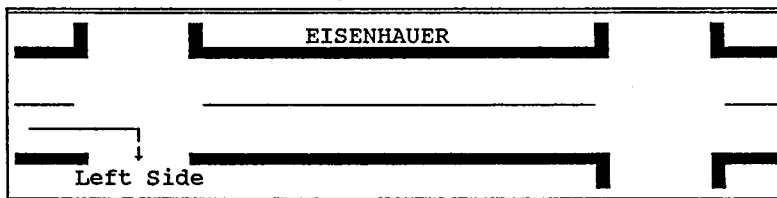
Cross Street Name            Permitted Left Turns (Y/N)  
 EISENHAUER                Left-side: N Right-side: N

Interior-Travel-Time		Interior-Queue-Storage			
--Rgt-->	<--Lft--	Left-Side	Right-Side		
(Sec)	(Sec)	Left Thru	Left Thru		
11	11	10	10	7	13

SIGNAL PHASING DATA

Type of Phasing	Run Delay-Offset Analysis (Y/N)	----- Seconds Offset ----- Forced Int.	Forced Ext.
Lead-Lead	N		
Lag-Lead	N		
Lead-Lag	N		
Lag-Lag	N		
TTI-Lead	N	12	

Esc:exit screen      PgUp/PgDn:next interchange



Vol/ Hour	Sat Flow	Min Green	CROSS-STREET	Vol/ Hour	Sat Flow	Min Green
67	359		right-turn	0	0	
232	1350	40	straight-through	206	1800	24
513	1619		straight-then-left	201	1749	
			FRONTAGE ROAD			
0	0		right-turn	0	0	
66	809	14	straight-through	151	1619	18
164	2019		left-then-straight	106	1439	
44	413		left-then-left	34	269	
			INTERIOR			
196	900	26	left-turn	609	1439	28
470	2250	46	straight-through	435	1749	46

Esc:exit screen      PgUp/PgDn:next interchange

<GID01>

TEXAS DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION  
DIAMOND INTERCHANGE SIGNALIZATION - 145105  
PASSER III-88

PASSER3

VER 1.0  
SEPT 88

PPPP	AAA	SSS	SSS	EEEE	RRRR	IIIIIIIIIIII
P P	A A	S S	S S	E E	R R	I I I
P P	A A	S S	S S	E E	R R	I I I
PPPP	AAAA	SSS	SSS	EEEE	RRRR	I I I
P	A A	S	S	E	R R	I I I
P	A A	S S	S S	E	R R	I I I
P	A A	SSS	SSS	EEEE	R R	IIIIIIIIIIII

\*\*\*\*\* GENERAL IDENTIFICATION DATA \*\*\*\*\*

FREeway NAME - - - USERS MANUAL EXAMPLE 1  
 CITY NAME - - - - - SAN ANTONIO  
 DISTRICT NUMBER - - - - - 15  
 DATE - - - - - 09/15/88  
 RUN NUMBER - - - - - 1

<GID02>

\*\*\*\*\* ISOLATED INTERCHANGE OPERATION \*\*\*\*\*

\*\*\* PARAMETERS \*\*\*

NUMBER OF INTERCHANGES - - - - 1  
 LOWER CYCLE LIMIT (SEC) - - - - 100  
 UPPER CYCLE LIMIT (SEC) - - - - 100  
 CYCLE INCREMENT (SEC) - - - - 0

\*\*\* OPTIONS \*\*\*

OPTIMIZE INTERNAL OFFSETS ? - - NO  
 EVALUATE INTERNAL OFFSETS ? - - YES



<IMD01A>

\*\*\* INTERCHANGE 1 EISENHAUER

RUN 1 PAGE 2A

\*\*\* LEFT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
ARTERIAL			
RIGHT-TURN	67	359	-
STRAIGHT-THROUGH	232	1350	40
STRAIGHT-THEN-LEFT	513	1619	-
FRONTAGE ROAD			
RIGHT-TURN	0	0	-
STRAIGHT-THROUGH	66	809	14
LEFT-THEN-STRAIGHT	164	2019	-
LEFT-THEN-LEFT	44	413	-
INTERIOR			
LEFT-TURN	196	900	26
STRAIGHT-THROUGH	470	2250	46

<IMD01B>

\*\*\* INTERCHANGE 1 EISENHAUER

RUN 1 PAGE 2B

\*\*\* RIGHT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
ARTERIAL			
RIGHT-TURN	0	0	-
STRAIGHT-THROUGH	206	1800	24
STRAIGHT-THEN-LEFT	201	1749	-
FRONTAGE ROAD			
RIGHT-TURN	0	0	-
STRAIGHT-THROUGH	151	1619	18
LEFT-THEN-STRAIGHT	106	1439	-
LEFT-THEN-LEFT	34	269	-
INTERIOR			
LEFT-TURN	609	1439	28
STRAIGHT-THROUGH	435	1749	46

<DOI01>

\*\*\* INTERCHANGE 1 EISENHAUER

RUN 1 PAGE 3

\*\*\* INTERNAL DELAY-OFFSET INFORMATION \*\*\*

```

*****
PHASING      OPTIMIZE?  FORCE?          INTERIOR QUEUE STORAGE
*****
LEAD-LEAD    N          -      THROUGH MOVEMENT AT LEFT SIDE (VEH)  10
LAG -LEAD    N          -      LEFT-TURN MOVEMENT AT LEFT SIDE (VEH)  10
LEAD-LAG     N          -      THROUGH MOVEMENT AT RIGHT SIDE (VEH)  13
LAG -LAG     N          -      LEFT-TURN MOVEMENT AT RIGHT SIDE (VEH)  7
TTI -LEAD    N          12

```

```

*****
PERMITTED LEFT TURNS?          INTERIOR TRAVEL TIMES
*****
LEFT-SIDE INTERSECTION  NO      LEFT TO RIGHT (SEC)  - - - - - 11
RIGHT-SIDE INTERSECTION NO      RIGHT TO LEFT (SEC)  - - - - - 11

```

<GSI01>

\*\*\* INTERCHANGE 1 EISENHAUER

RUN 1 PAGE 4A

\*\*\* GENERAL SIGNALIZATION INFORMATION \*\*\*

```

*****
MEASURES OF LEFT-SIDE INTERSECTION * RIGHT-SIDE INTERSECTION
EFFECTIVENESS A B C A+C * A B C A+C
*****
PHASE TIME (SEC) 50.5 19.5 30.0 80.5 * 24.0 24.0 52.0 76.0
V/C RATIO .68 .69 .84 .27 * .57 .63 .88 .35
LEVEL OF SERVICE B B D A * A B E A
DELAY (SEC/VEH) 23.24 61.91 42.42 .00 * 38.37 54.66 20.99 .87
LEVEL OF SERVICE C E D A * D E C A
STORAGE RATIO .41 .00 * .81 .09
LEVEL OF SERVICE D A * F B
*****
PHASE ORDER TTI -LEAD TOTAL INTERCHANGE DELAY 21.55 VEH-HRS/HR
INTERNAL OFFSET 12 SEC

```

<SPI01>

\*\*\* INTERCHANGE 1 EISENHAUER

RUN 1 PAGE 4B

\*\*\* SIGNAL PHASING INFORMATION \*\*\*

```

*****
* LEFT-SIDE SEQUENCE * RIGHT-SIDE SEQUENCE *
* A B C * A B C *
PHASE INTERVAL * <---- | <---- * <---- ^ ^ * PHASE INTERVAL
NUMBER * ----> | V V * ----> | ----> * LENGTH (SEC)
* * * * *
1 * A * B * 12.00
2 * A * C * 38.50
3 * B * C * 13.50
4 * B * A * 6.00
5 * C * A * 18.00
6 * C * B * 12.00
* * * * *
INTERNAL OFFSET 12 SEC CYCLE LENGTH 100 SEC
PHASE ORDER TTI -LEAD

```

## Example 2: Frontage Road Progression

Once the **MAIN MENU** has appeared on the screen, you should press the letter "F" (**File-Data Set Options**) and change the workfile name from "EXAMPLE" to "TEST03." You should then press the Enter key to enter the workfile name, the <Esc> key to return to the **MAIN MENU**, the letter "E" (**Edit-Define or Modify Data**), and enter the data exactly as shown in the General Freeway Identification, Signal Phasing, and Movement-Interchange Data screens on the following pages. Forward transfer between screens is accomplished by pressing the <Esc> key which will also automatically return you to the **MAIN MENU** at the completion of data entry. You can then either edit the data, if corrections are needed, or run the program by pressing the letter "R" (**Run-PASSER III-88**). If the data were entered exactly as shown, the output file shown on the following pages can be either viewed and/or printed from the **OUTPUT MENU**.

This example is an optimization of a progression solution through a series of four signalized diamond interchanges connected by continuous one-way frontage roads. Several observations can be made concerning the input data from this problem. First, cycle length and green splits are not being optimized; i.e., the cycle length and sum of the conflicting minimum greens is 65 seconds at all four interchanges. Second, four specified signal timing plans (phase sequences and internal offsets) are allowable choices for frontage road progression at three of the interchanges. At the other interchange, El Paso Street, three specified signal timing plans and one individually optimized signal timing plan are allowable choices for frontage road progression. Finally, with the exception of Dallas Avenue, the relatively low saturation flow rates for interior left-turns suggest the presence of shared rather than exclusive turning lanes. There is also little space for storing interior left-turning or through vehicles at any of the interchanges.

The output from this problem is straightforward and relatively easy to interpret. The average progression speed and bandwidth are 33.7 miles per hour and 24.2 seconds, respectively. The progression solution's efficiency was 0.37 and its attainability was 0.82, both of which are indicative of a relatively good solution. Lag-lag phasing was selected as the optimal phasing at Houston Avenue, Dallas Avenue, and Elgin Boulevard and lead-lag phasing was selected as the optimal phasing at El Paso Street. There are no apparent operational problems at any of the interchanges; i.e., most interchange movements are operating at Level-of-Service "C" or better, and no movements are operating at worse than Level-of-Service "D." In other words, it would probably be an acceptable solution to most engineering professionals.

P A S S E R III - 88  
Texas Department of Highways & Public Transportation

Version 1.0

W E L C O M E TO

```
PPPPPPPP      AAA      SSSSSSS      SSSSSSS      EEEEEEEE      RRRRRRR
PP   PP      AA AA      SS          SS          EE          RR   RR
PPPPPPPP      AAAAAAA      SSSSSSS      SSSSSSS      EEEEEEE      RRRRRRR
PP      AA   AA      SS          SS          EE          RR   RR
PP      AA      AA      SSSSSSS      SSSSSSS      EEEEEEEE      RR   RR
```

```
      III III III      8888      8888
      II  II  II      88 88 88 88
      II  II  II ==      8888      8888
      II  II  II      88 88 88 88
      III III III      8888      8888
```

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Is September 15, 1988 the correct date (Y/N)?

Y

P A S S E R III - 88  
Texas Department of Highways & Public Transportation

Version 1.0

FREEWAY IDENTIFICATION

Run Number: 02 Freeway Name: USERS MANUAL EXAMPLE 2  
District : 15 City Name: SAN ANTONIO  
Number of Interchanges (1 for isolated analysis) : 4

-----CYCLE LENGTHS-----

Lower: 65 Upper: 65 Incr: █

Calculate Band Split Proportional to Traffic?(Y/N): N  
"A" direction Percentage ( 0 to 100 ): 50  
Speed Search? (Y/N): Y

Time/Space Diagram (Y/N): Y

-----PLOT SCALING / INCH-----  
Horizontal (Seconds): 0 Vertical (Feet): 0

Note: Set to 0 for program selected values

Escape key to exit screen

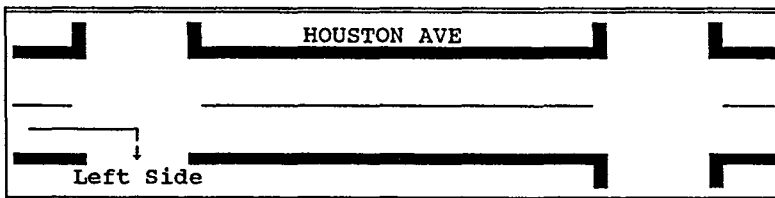
INTERCHANGE 1 DATA

Cross Street Name	Permitted Left Turns (Y/N)	
HOUSTON AVE	Left-side: Y	Right-side: Y
Interior-Travel-Time	Interior-Queue-Storage	
--Rgt--> <---Lft--	Left-Side	Right-Side
(Sec) (Sec)	Left Thru	Left Thru
8 10	6 10	10 10

SIGNAL PHASING DATA

Type of Phasing	Run Delay-Offset Analysis (Y/N)	----- Seconds Offset -----
		Forced Int. Forced Ext.
Lead-Lead	N	51
Lag-Lead	N	62
Lead-Lag	N	51
Lag-Lag	N	62
TTI-Lead	N	

Esc:exit screen PgUp/PgDn:next interchange



Vol/ Hour	Sat Flow	Min Green	CROSS-STREET	Vol/ Hour	Sat Flow	Min Green
50	719		right-turn	70	2303	
140	2159	14	straight-through	10	323	12
50	719		straight-then-left	30	971	
			FRONTAGE ROAD			
40	161		right-turn	220	809	
900	4427	40	straight-through	900	4481	37
160	809		left-then-straight	30	107	
0	0		left-then-left	0	0	
			INTERIOR			
30	1547	11	left-turn	40	431	16
40	2051	25	straight-through	300	3167	28

Esc:exit screen PgUp/PgDn:next interchange

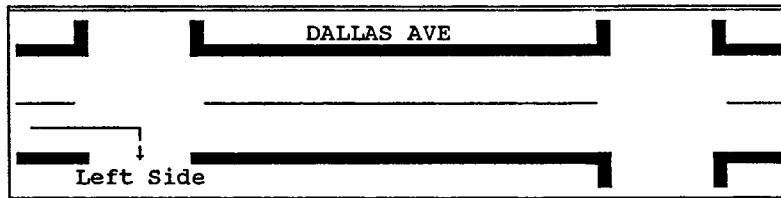
INTERCHANGE 2 DATA

Cross Street Name DALLAS AVE..	Permitted Left Turns (Y/N) Left-side: Y Right-side: Y
Interior-Travel-Time --Rgt--> <--Lft-- (Sec) (Sec)	Interior-Queue-Storage Left-Side Right-Side Left Thru Left Thru
8 12	6 10 10 10

SIGNAL PHASING DATA

Type of Phasing	Run Delay-Offset Analysis (Y/N)	----- Seconds Offset ----- Forced Int. Forced Ext.
Lead-Lead	N	53
Lag-Lead	N	64
Lead-Lag	N	53
Lag-Lag	N	64
TTI-Lead	N	

Esc:exit screen PgUp/PgDn:next interchange



Vol/ Hour	Sat Flow	Min Green	CROSS-STREET	Vol/ Hour	Sat Flow	Min Green
280	1495		right-turn	20	539	
150	647	24	straight-through	100	2771	12
280	1495		straight-then-left	10	287	
			FRONTAGE ROAD			
40	161		right-turn	40	215	
900	4643	30	straight-through	870	4751	29
130	593		left-then-straight	80	431	
0	0		left-then-left	0	0	
			INTERIOR			
10	1800	11	left-turn	350	1800	24
180	3600	35	straight-through	280	3600	36

Esc:exit screen PgUp/PgDn:next interchange

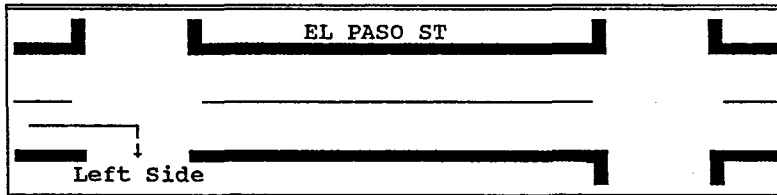
INTERCHANGE 3 DATA

Cross Street Name	Permitted Left Turns (Y/N)
EL-PASO-ST	Left-side: N Right-side: N
Interior-Travel-Time	Interior-Queue-Storage
--Rgt--> <---Lft--	Left-Side Right-Side
(Sec) (Sec)	Left Thru Left Thru
10 12	6 10 6 10

SIGNAL PHASING DATA

Type of Phasing	Run Delay-Offset Analysis (Y/N)	----- Seconds Offset -----
		Forced Int. Forced Ext.
Lead-Lead	N	49
Lag-Lead	N	0
Lead-Lag	N	49
Lag-Lag	Y	
TTI-Lead	N	

Esc:exit screen PgUp/PgDn:next interchange



Vol/	Sat	Min		Vol/	Sat	Min
Hour	Flow	Green	CROSS-STREET	Hour	Flow	Green
70	647		right-turn	20	323	
200	1835	19	straight-through	150	2339	14
120	1115		straight-then-left	60	935	
			FRONTAGE ROAD			
20	107		right-turn	100	539	
900	4697	30	straight-through	800	4319	30
120	593		left-then-straight	100	539	
0	0		left-then-left	0	0	
			INTERIOR			
60	683	16	left-turn	120	971	21
250	2915	35	straight-through	320	2627	35

Esc:exit screen PgUp/PgDn:next interchange



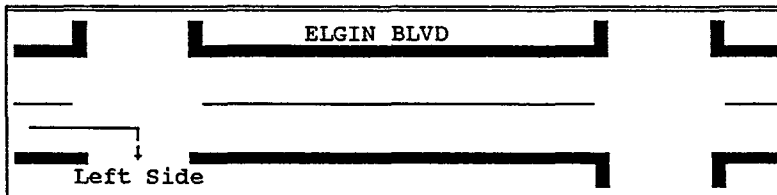
INTERCHANGE 4 DATA

Cross Street Name	Permitted Left Turns (Y/N)			
ELGIN·BLVD··	Left-side: Y		Right-side: Y	
Interior-Travel-Time	Interior-Queue-Storage			
--Rgt--> <---Lft--	Left-Side		Right-Side	
(Sec)	(Sec)	Left Thru	Left Thru	
10	12	8	8	8

SIGNAL PHASING DATA

Type of Phasing	Run Delay-Offset Analysis (Y/N)	----- Seconds Offset -----	Forced Int.	Forced Ext.
Lead-Lead	N		48	
Lag-Lead	N		62	
Lead-Lag	N		48	
Lag-Lag	N		62	
TTI-Lead	N			

Esc:exit screen PgUp/PgDn:next interchange



Vol/ Hour	Sat Flow	Min Green	CROSS-STREET	Vol/ Hour	Sat Flow	Min Green
80	575		right-turn	5	71	
220	1583	18	straight-through	200	2195	14
200	1439		straight-then-left	120	1331	
			FRONTAGE ROAD			
15	53		right-turn	10	53	
900	4805	33	straight-through	920	5021	30
110	539		left-then-straight	60	323	
0	0		left-then-left	0	0	
			INTERIOR			
120	1151	14	left-turn	200	1367	21
260	1447	32	straight-through	330	2231	35

Esc:exit screen PgUp/PgDn:next interchange

FRONTAGE ROAD PROGRESSION DATA

Link Name		From -----> To			To <----- From		
From:	HOUSTON AVE	Dist	Speed	Que Clr	Dist	Speed	Que Clr
To:	DALLAS AVE	(Ft)	(MPH)	(Sec)	(Ft)	(MPH)	(Sec)
HOUSTON AVE	DALLAS AVE	1900	35	0	1900	35	0
DALLAS AVE	EL PASO ST	2650	30	0	2650	30	0
EL PASO ST	ELGIN BLVD	2220	38	0	2220	38	0

Esc:exit screen

PgUp/PgDn:next link

<GID01>

TEXAS DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION  
DIAMOND INTERCHANGE SIGNALIZATION - 145105  
PASSER III-88

PASSER3

VER 1.0  
SEPT 88

PPPP	AAA	SSS	SSS	EEEE	RRRR	IIIIIIIIIIII
P P	A A	S S	S S	E	R R	I I I
P P	A A	S	S	E	R R	I I I
PPPP	AAAAA	SSS	SSS	EEEE	RRRR	I I I
P	A A	S	S	E	R R	I I I
P	A A	S S	S S	E	R R	I I I
P	A A	SSS	SSS	EEEE	R R	IIIIIIIIIIII

\*\*\*\*\* GENERAL IDENTIFICATION DATA \*\*\*\*\*

FREEWAY NAME - - - USERS MANUAL EXAMPLE 2  
 CITY NAME - - - - - SAN ANTONIO  
 DISTRICT NUMBER - - - - - 15  
 DATE - - - - - 09/15/88  
 RUN NUMBER - - - - - 2

<GID02>

\*\*\*\*\* FRONTAGE ROAD PROGRESSION INFORMATION \*\*\*\*\*

\*\*\* PARAMETERS \*\*\*

NUMBER OF INTERCHANGES - - - - - 4  
 LOWER CYCLE LIMIT (SEC) - - - - - 65  
 UPPER CYCLE LIMIT (SEC) - - - - - 65  
 CYCLE INCREMENT (SEC) - - - - - 0  
 MIN. ' A ' DIRECTION BAND SPLIT (%) - 50

\*\*\* OPTIONS \*\*\*

OPTIMIZE INTERNAL OFFSETS ? - - - - - YES  
 EVALUATE INTERNAL OFFSETS ? - - - - - YES  
 VARY LINK SPEEDS ? - - - - - YES  
 EVALUATE EXTERNAL OFFSETS ? - - - - - NO

<IMD01A>

\*\*\* INTERCHANGE 1 HOUSTON AVE

RUN 2 PAGE 2A

\*\*\* LEFT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
ARTERIAL			
RIGHT-TURN	50	719	-
STRAIGHT-THROUGH	140	2159	14
STRAIGHT-THEN-LEFT	50	719	-
FRONTAGE ROAD			
RIGHT-TURN	40	161	-
STRAIGHT-THROUGH	900	4427	40
LEFT-THEN-STRAIGHT	160	809	-
LEFT-THEN-LEFT	0	0	-
INTERIOR			
LEFT-TURN	30	1547	11
STRAIGHT-THROUGH	40	2051	25

<IMD01B>

\*\*\* INTERCHANGE 1 HOUSTON AVE

RUN 2 PAGE 2B

\*\*\* RIGHT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
ARTERIAL			
RIGHT-TURN	70	2303	-
STRAIGHT-THROUGH	10	323	12
STRAIGHT-THEN-LEFT	30	971	-
FRONTAGE ROAD			
RIGHT-TURN	220	809	-
STRAIGHT-THROUGH	900	4481	37
LEFT-THEN-STRAIGHT	30	107	-
LEFT-THEN-LEFT	0	0	-
INTERIOR			
LEFT-TURN	40	431	16
STRAIGHT-THROUGH	300	3167	28

<IMD02A>

\*\*\* INTERCHANGE 2 DALLAS AVE

RUN 2 PAGE 3A

\*\*\* LEFT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
*****			
ARTERIAL			
RIGHT-TURN	280	1495	-
STRAIGHT-THROUGH	150	647	24
STRAIGHT-THEN-LEFT	280	1495	-
FRONTAGE ROAD			
RIGHT-TURN	40	161	-
STRAIGHT-THROUGH	900	4643	30
LEFT-THEN-STRAIGHT	130	593	-
LEFT-THEN-LEFT	0	0	-
INTERIOR			
LEFT-TURN	10	1800	11
STRAIGHT-THROUGH	180	3600	35

<IMD02B>

\*\*\* INTERCHANGE 2 DALLAS AVE

RUN 2 PAGE 3B

\*\*\* RIGHT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
*****			
ARTERIAL			
RIGHT-TURN	20	539	-
STRAIGHT-THROUGH	100	2771	12
STRAIGHT-THEN-LEFT	10	287	-
FRONTAGE ROAD			
RIGHT-TURN	40	215	-
STRAIGHT-THROUGH	870	4751	29
LEFT-THEN-STRAIGHT	80	431	-
LEFT-THEN-LEFT	0	0	-
INTERIOR			
LEFT-TURN	350	1800	24
STRAIGHT-THROUGH	280	3600	36

<IMD03A>

\*\*\* INTERCHANGE 3 EL PASO ST

RUN 2 PAGE 4A

\*\*\* LEFT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
ARTERIAL			
RIGHT-TURN	70	647	-
STRAIGHT-THROUGH	200	1835	19
STRAIGHT-THEN-LEFT	120	1115	-
FRONTAGE ROAD			
RIGHT-TURN	20	107	-
STRAIGHT-THROUGH	900	4697	30
LEFT-THEN-STRAIGHT	120	593	-
LEFT-THEN-LEFT	0	0	-
INTERIOR			
LEFT-TURN	60	683	16
STRAIGHT-THROUGH	250	2915	35

<IMD03B>

\*\*\* INTERCHANGE 3 EL PASO ST

RUN 2 PAGE 4B

\*\*\* RIGHT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
ARTERIAL			
RIGHT-TURN	20	323	-
STRAIGHT-THROUGH	150	2339	14
STRAIGHT-THEN-LEFT	60	935	-
FRONTAGE ROAD			
RIGHT-TURN	100	539	-
STRAIGHT-THROUGH	800	4319	30
LEFT-THEN-STRAIGHT	100	539	-
LEFT-THEN-LEFT	0	0	-
INTERIOR			
LEFT-TURN	120	971	21
STRAIGHT-THROUGH	320	2627	35

<IMD04A>

\*\*\* INTERCHANGE 4 ELGIN BLVD

RUN 2 PAGE 5A

\*\*\* LEFT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
ARTERIAL			
RIGHT-TURN	80	575	-
STRAIGHT-THROUGH	220	1583	18
STRAIGHT-THEN-LEFT	200	1439	-
FRONTAGE ROAD			
RIGHT-TURN	15	53	-
STRAIGHT-THROUGH	900	4805	33
LEFT-THEN-STRAIGHT	110	539	-
LEFT-THEN-LEFT	0	0	-
INTERIOR			
LEFT-TURN	120	1151	14
STRAIGHT-THROUGH	260	1447	32

<IMD04B>

\*\*\* INTERCHANGE 4 ELGIN BLVD

RUN 2 PAGE 5B

\*\*\* RIGHT-SIDE MOVEMENT DATA \*\*\*

TRAFFIC MOVEMENT	VOLUME (VPH)	SATURATION FLOW (VPHG)	MINIMUM PHASE (SEC)
ARTERIAL			
RIGHT-TURN	5	71	-
STRAIGHT-THROUGH	200	2195	14
STRAIGHT-THEN-LEFT	120	1331	-
FRONTAGE ROAD			
RIGHT-TURN	10	53	-
STRAIGHT-THROUGH	920	5021	30
LEFT-THEN-STRAIGHT	60	323	-
LEFT-THEN-LEFT	0	0	-
INTERIOR			
LEFT-TURN	200	1367	21
STRAIGHT-THROUGH	330	2231	35

<DOI01>

\*\*\* INTERCHANGE 1 HOUSTON AVE

RUN 2 PAGE 6

\*\*\* INTERNAL DELAY-OFFSET INFORMATION \*\*\*

```

* * * * *
PHASING      OPTIMIZE?  FORCE?          INTERIOR QUEUE STORAGE
* * * * *

```

```

LEAD-LEAD      N          51    THROUGH MOVEMENT AT LEFT SIDE (VEH)  10
LAG -LEAD      N          62    LEFT-TURN MOVEMENT AT LEFT SIDE (VEH)  6
LEAD-LAG      N          51    THROUGH MOVEMENT AT RIGHT SIDE (VEH)  10
LAG -LAG      N          62    LEFT-TURN MOVEMENT AT RIGHT SIDE (VEH) 10
TTI -LEAD     N          -

```

```

* * * * *
PERMITTED LEFT TURNS?          INTERIOR TRAVEL TIMES
* * * * *

```

```

LEFT-SIDE INTERSECTION  YES    LEFT TO RIGHT (SEC)  - - - - - 8
RIGHT-SIDE INTERSECTION YES    RIGHT TO LEFT (SEC) - - - - - 10

```

<DOI02>

\*\*\* INTERCHANGE 2 DALLAS AVE

RUN 2 PAGE 7

\*\*\* INTERNAL DELAY-OFFSET INFORMATION \*\*\*

```

* * * * *
PHASING      OPTIMIZE?  FORCE?          INTERIOR QUEUE STORAGE
* * * * *

```

```

LEAD-LEAD      N          53    THROUGH MOVEMENT AT LEFT SIDE (VEH)  10
LAG -LEAD      N          64    LEFT-TURN MOVEMENT AT LEFT SIDE (VEH)  6
LEAD-LAG      N          53    THROUGH MOVEMENT AT RIGHT SIDE (VEH)  10
LAG -LAG      N          64    LEFT-TURN MOVEMENT AT RIGHT SIDE (VEH) 10
TTI -LEAD     N          -

```

```

* * * * *
PERMITTED LEFT TURNS?          INTERIOR TRAVEL TIMES
* * * * *

```

```

LEFT-SIDE INTERSECTION  YES    LEFT TO RIGHT (SEC)  - - - - - 8
RIGHT-SIDE INTERSECTION YES    RIGHT TO LEFT (SEC) - - - - - 12

```



<DOI03>

\*\*\* INTERCHANGE 3 EL PASO ST

RUN 2 PAGE 8

\*\*\* INTERNAL DELAY-OFFSET INFORMATION \*\*\*

PHASING	OPTIMIZE?	FORCE?	INTERIOR QUEUE STORAGE
LEAD-LEAD	N	49	THROUGH MOVEMENT AT LEFT SIDE (VEH) 10
LAG -LEAD	N	0	LEFT-TURN MOVEMENT AT LEFT SIDE (VEH) 6
LEAD-LAG	N	49	THROUGH MOVEMENT AT RIGHT SIDE (VEH) 10
LAG -LAG	Y	-	LEFT-TURN MOVEMENT AT RIGHT SIDE (VEH) 6
TTI -LEAD	N	-	

PERMITTED LEFT TURNS?	INTERIOR TRAVEL TIMES
LEFT-SIDE INTERSECTION	NO LEFT TO RIGHT (SEC) - - - - - 10
RIGHT-SIDE INTERSECTION	NO RIGHT TO LEFT (SEC) - - - - - 12

<DOI04>

\*\*\* INTERCHANGE 4 ELGIN BLVD

RUN 2 PAGE 9

\*\*\* INTERNAL DELAY-OFFSET INFORMATION \*\*\*

PHASING	OPTIMIZE?	FORCE?	INTERIOR QUEUE STORAGE
LEAD-LEAD	N	48	THROUGH MOVEMENT AT LEFT SIDE (VEH) 8
LAG -LEAD	N	62	LEFT-TURN MOVEMENT AT LEFT SIDE (VEH) 8
LEAD-LAG	N	48	THROUGH MOVEMENT AT RIGHT SIDE (VEH) 8
LAG -LAG	N	62	LEFT-TURN MOVEMENT AT RIGHT SIDE (VEH) 8
TTI -LEAD	N	-	

PERMITTED LEFT TURNS?	INTERIOR TRAVEL TIMES
LEFT-SIDE INTERSECTION	YES LEFT TO RIGHT (SEC) - - - - - 10
RIGHT-SIDE INTERSECTION	YES RIGHT TO LEFT (SEC) - - - - - 12

<LGI01>

\*\*\* LINK GEOMETRY \*\*\*

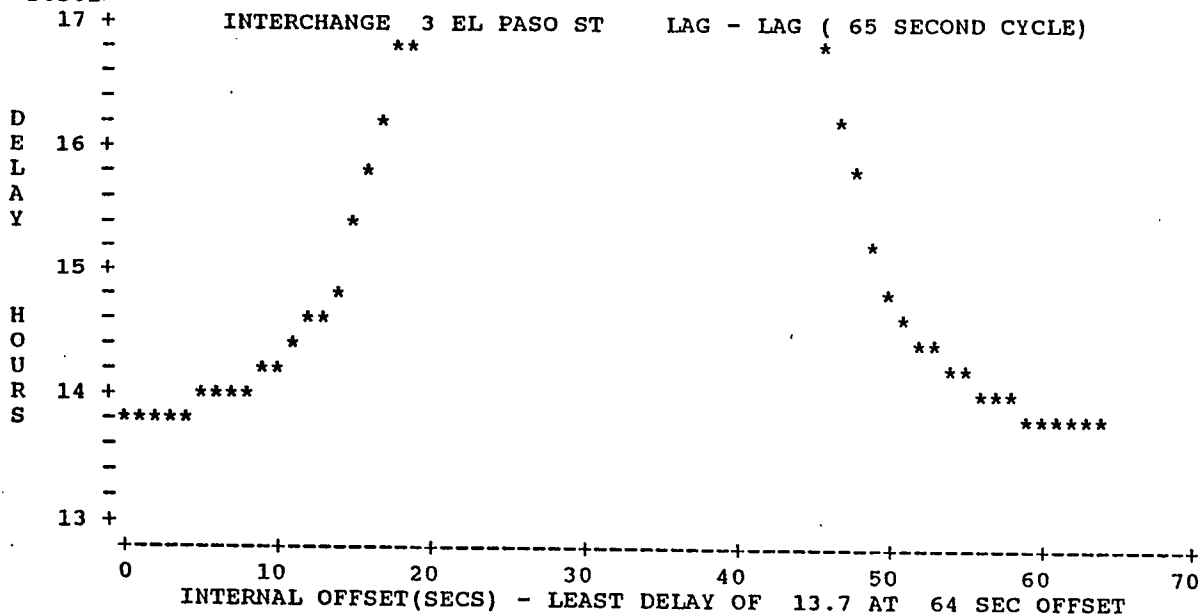
RUN 2 PAGE 10

```

*****
'A' DIRECTION          'B' DIRECTION
LINK NAME             FRONTAGE ROAD      FRONTAGE ROAD
                     DISTANCE SPEED  QUEUE    DISTANCE SPEED  QUEUE
                     (FT)   (MPH) CLEARANCE (FT)   (MPH) CLEARANCE
*****
HOUSTON AVE TO DALLAS AVE    1900   35     0      1900   35     0
DALLAS AVE TO EL PASO ST    2650   30     0      2650   30     0
EL PASO ST TO ELGIN BLVD    2220   38     0      2220   38     0

```

<DOD01>



<OPS01>

\*\*\* OPTIMAL PROGRESSION SOLUTION \*\*\* RUN 2 PAGE 11A

USERS MANUAL EXAMPLE 2

\*\*\*\*\*

CYCLE LENGTH (SEC) - - - - - 65

'A' DIRECTION

PROGRESSION SPEED (MPH) - - 33.7

BANDWIDTH (SEC) - - - - - 24.2

'B' DIRECTION

PROGRESSION SPEED (MPH) - - 33.7

BANDWIDTH (SEC) - - - - - 24.2

EFFICIENCY - - - - - .37

ATTAINABILITY - - - - - .82

<FRP01>

\*\*\* FRONTAGE ROAD PROGRESSION INFORMATION \*\*\* RUN 2 PAGE 11B

USERS MANUAL EXAMPLE 2

\*\*\*\*\*  
INTERCHANGE SIGNAL INTERNAL EXTERNAL 'A' DIRECTION 'B' DIRECTION  
CROSS STREET PHASING OFFSET OFFSET TRAVEL TIME TRAVEL TIME  
NAME SEQUENCE (SEC) (SEC) (SEC) (SEC)  
\*\*\*\*\*

INTERCHANGE CROSS STREET NAME	SIGNAL PHASING SEQUENCE	INTERNAL OFFSET (SEC)	EXTERNAL OFFSET (SEC)	'A' DIRECTION TRAVEL TIME (SEC)	'B' DIRECTION TRAVEL TIME (SEC)
HOUSTON AVE	LAG -LAG	62	.0	8.2	175.3
DALLAS AVE	LAG -LAG	64	23.2	49.7	132.8
EL PASO ST	LEAD-LAG	49	38.2	117.3	58.7
ELGIN BLVD	LAG -LAG	62	56.2	160.2	14.5

<GSI01>

\*\*\* INTERCHANGE 1 HOUSTON AVE

RUN 2 PAGE 12A

\*\*\* GENERAL SIGNALIZATION INFORMATION \*\*\*

MEASURES OF EFFECTIVENESS	LEFT-SIDE INTERSECTION				*	RIGHT-SIDE INTERSECTION				
	A	B	C	A+C		A	B	C	A+C	
PHASE TIME (SEC)	14.0	40.0	11.0	25.0	*	12.0	37.0	16.0	28.0	
V/C RATIO	.45	.45	.18	.06	*	.25	.55	.50	.26	
LEVEL OF SERVICE	A	A	A	A	*	A	A	A	A	
DELAY (SEC/VEH)	27.62	11.72	1.50	13.37	*	26.71	21.57	.26	10.28	
LEVEL OF SERVICE	C	B	A	B	*	C	C	A	B	
STORAGE RATIO			.06	.05	*			.01	.26	
LEVEL OF SERVICE			B	A	*			A	C	
PHASE ORDER	LAG -LAG					TOTAL INTERCHANGE DELAY				9.53 VEH-HRS/HR
INTERNAL OFFSET	62 SEC									

<SPI01>

\*\*\* INTERCHANGE 1 HOUSTON AVE

RUN 2 PAGE 12B

\*\*\* SIGNAL PHASING INFORMATION \*\*\*

PHASE INTERVAL NUMBER	LEFT-SIDE SEQUENCE			*	RIGHT-SIDE SEQUENCE			PHASE INTERVAL LENGTH (SEC)
	A	C	B		A	C	B	
1				*				
2		A		*	A			9.00
3		A		*	C			5.00
4		C		*	C			11.00
5		B		*	B			37.00
		B		*	A			3.00
INTERNAL OFFSET	62 SEC				CYCLE LENGTH			65 SEC
EXTERNAL OFFSET	.0 SEC				PHASE ORDER			LAG -LAG

<GSI01>

\*\*\* INTERCHANGE 2 DALLAS AVE

RUN 2 PAGE 13A

\*\*\* GENERAL SIGNALIZATION INFORMATION \*\*\*

```

* * * * *
MEASURES OF LEFT-SIDE INTERSECTION * RIGHT-SIDE INTERSECTION
EFFECTIVENESS A B C A+C * A B C A+C
* * * * *
PHASE TIME (SEC) 24.0 30.0 11.0 35.0 * 12.0 29.0 24.0 36.0
V/C RATIO .75 .62 .05 .10 * .30 .48 .63 .16
LEVEL OF SERVICE C B A A * A A B A
DELAY (SEC/VEH) 33.28 30.05 3.14 4.64 * 27.42 19.53 .77 6.54
LEVEL OF SERVICE D C A A * C C A B
STORAGE RATIO .03 .13 * .04 .22
LEVEL OF SERVICE A C * A C
* * * * *
PHASE ORDER LAG -LAG TOTAL INTERCHANGE DELAY 15.43 VEH-HRS/HR
INTERNAL OFFSET 64 SEC

```

<SPI01>

\*\*\* INTERCHANGE 2 DALLAS AVE

RUN 2 PAGE 13B

\*\*\* SIGNAL PHASING INFORMATION \*\*\*

```

* * * * *
* LEFT-SIDE SEQUENCE * RIGHT-SIDE SEQUENCE *
* A C B * A C B *
PHASE INTERVAL * <---- <---- | * <---- ^ ^ * PHASE INTERVAL
NUMBER * |---- V | * ----| | * LENGTH (SEC)
* ----> V V * ----> ----> | *
* * * * *
1 * A * A * 11.00
2 * A * C * 13.00
3 * C * C * 11.00
4 * B * B * 29.00
5 * B * A * 1.00
* * * * *
INTERNAL OFFSET 64 SEC CYCLE LENGTH 65 SEC
EXTERNAL OFFSET 23.2 SEC PHASE ORDER LAG -LAG

```

<GSI01>

\*\*\* INTERCHANGE 3 EL PASO ST

RUN 2 PAGE 14A

\*\*\* GENERAL SIGNALIZATION INFORMATION \*\*\*

MEASURES OF EFFECTIVENESS	LEFT-SIDE INTERSECTION				*	RIGHT-SIDE INTERSECTION			
	A	B	C	A+C		A	B	C	A+C
PHASE TIME (SEC)	19.0	30.0	16.0	35.0	*	14.0	30.0	21.0	35.0
V/C RATIO	.47	.51	.48	.18	*	.42	.46	.47	.26
LEVEL OF SERVICE	A	A	A	A	*	A	A	A	A
DELAY (SEC/VEH)	23.81	21.48	43.46	4.29	*	28.45	15.87	9.76	9.45
LEVEL OF SERVICE	C	C	D	A	*	C	B	B	B
STORAGE RATIO			.15	.16	*			.07	.27
LEVEL OF SERVICE			C	C	*			B	C
PHASE ORDER LEAD-LAG				TOTAL INTERCHANGE DELAY		14.77		VEH-HRS/HR	
INTERNAL OFFSET 49 SEC									

<SPI01>

\*\*\* INTERCHANGE 3 EL PASO ST

RUN 2 PAGE 14B

\*\*\* SIGNAL PHASING INFORMATION \*\*\*

PHASE INTERVAL NUMBER	LEFT-SIDE SEQUENCE			RIGHT-SIDE SEQUENCE			PHASE INTERVAL LENGTH (SEC)
	A	B	C	A	C	B	
1	*	A	*	C	*	19.00	
2	*	B	*	B	*	30.00	
3	*	C	*	A	*	14.00	
4	*	C	*	C	*	2.00	
INTERNAL OFFSET 49 SEC				CYCLE LENGTH 65 SEC			
EXTERNAL OFFSET 38.2 SEC				PHASE ORDER LEAD-LAG			

<GSI01>

\*\*\* INTERCHANGE 4 ELGIN BLVD

RUN 2 PAGE 15A

\*\*\* GENERAL SIGNALIZATION INFORMATION \*\*\*

MEASURES OF EFFECTIVENESS	LEFT-SIDE INTERSECTION				*	RIGHT-SIDE INTERSECTION				
	A	B	C	A+C		A	B	C	A+C	
PHASE TIME (SEC)	18.0	33.0	14.0	32.0	*	14.0	30.0	21.0	35.0	
V/C RATIO	.65	.63	.68	.42	*	.59	.47	.56	.31	
LEVEL OF SERVICE	B	B	B	A	*	A	A	A	A	
DELAY (SEC/VEH)	32.90	48.73	7.66	4.80	*	45.77	27.87	2.47	4.37	
LEVEL OF SERVICE	D	D	B	A	*	D	C	A	A	
STORAGE RATIO			.20	.16	*			.10	.22	
LEVEL OF SERVICE			C	C	*			C	C	
PHASE ORDER	LAG -LAG					TOTAL INTERCHANGE DELAY				15.44 VEH-HRS/HR
INTERNAL OFFSET	62 SEC									

<SPI01>

\*\*\* INTERCHANGE 4 ELGIN BLVD

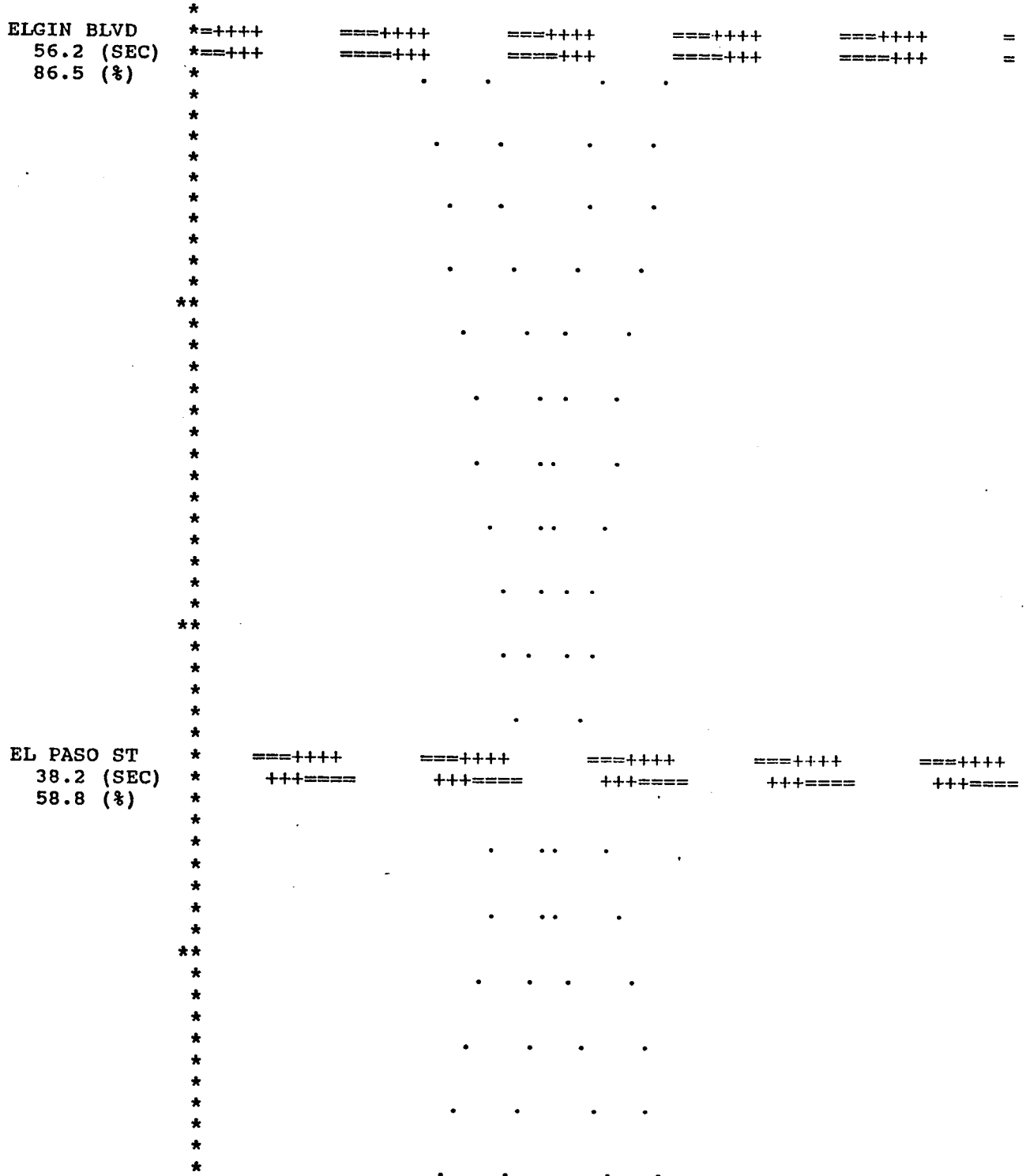
RUN 2 PAGE 15B

\*\*\* SIGNAL PHASING INFORMATION \*\*\*

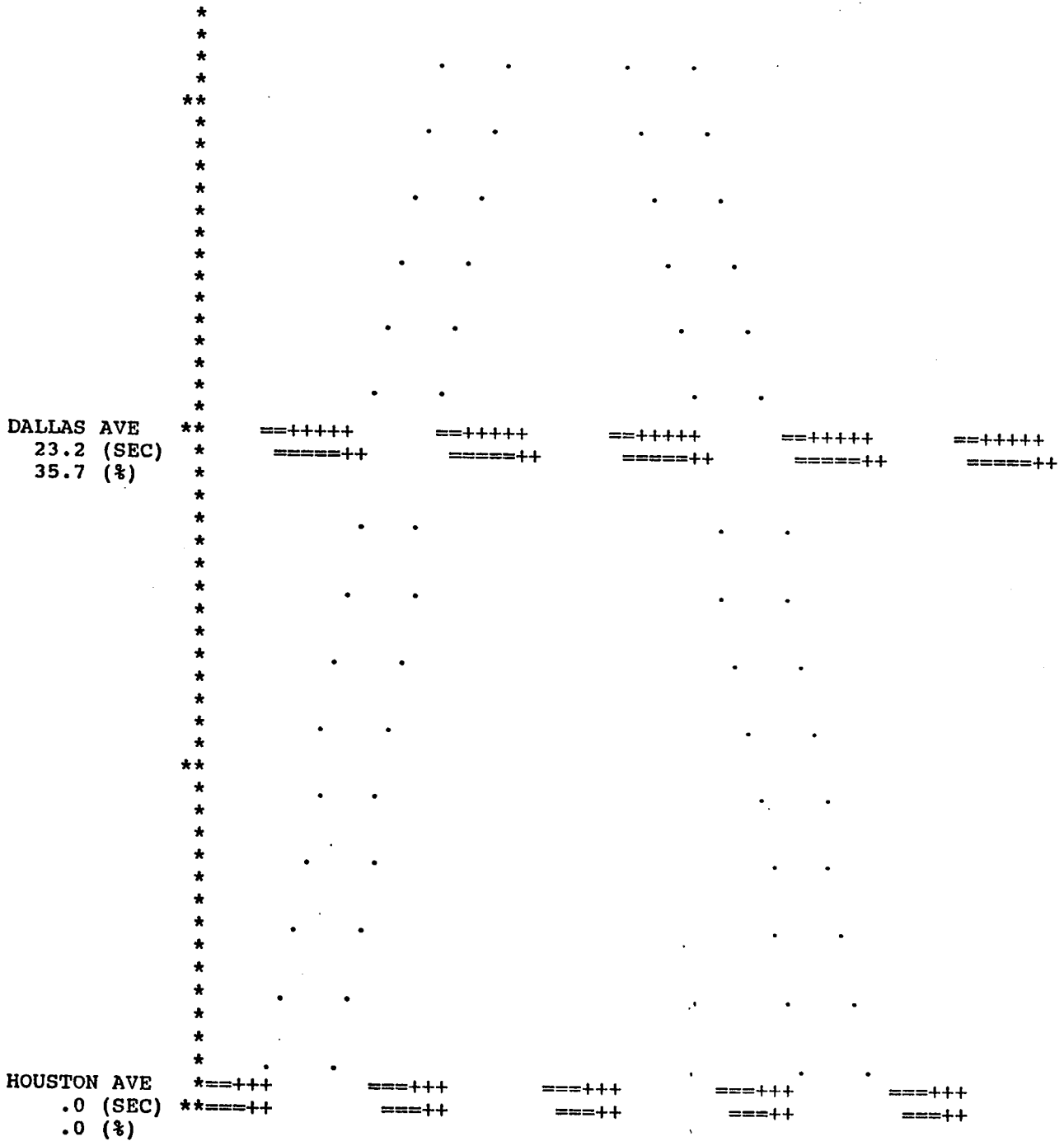
PHASE INTERVAL NUMBER	LEFT-SIDE SEQUENCE			RIGHT-SIDE SEQUENCE			PHASE INTERVAL LENGTH (SEC)
	A	C	B	A	C	B	
1	A			A			11.00
2	A			C			7.00
3		C		C			14.00
4		B		B			30.00
5		B		A			3.00
INTERNAL OFFSET	62 SEC			CYCLE LENGTH			65 SEC
EXTERNAL OFFSET	56.2 SEC			PHASE ORDER			LAG -LAG

<TSD01>

SAN ANTONIO DISTRICT 15 RUN NO. 2 HOR. SCALE 1 IN = 50 SEC  
USERS MANUAL EXAMPLE 2 CYCLE LENGTH = 65 SEC VER. SCALE 1 IN = 400 FT







'A' DIRECTION  
PROGRESSION SPEED - 33.7 MPH  
BANDWIDTH - 24.2 SECONDS

'B' DIRECTION  
PROGRESSION SPEED - 33.7 MPH  
BANDWIDTH - 24.2 SECONDS

PHASE A - =====  
PHASE B - BLANK  
PHASE C - ++++++

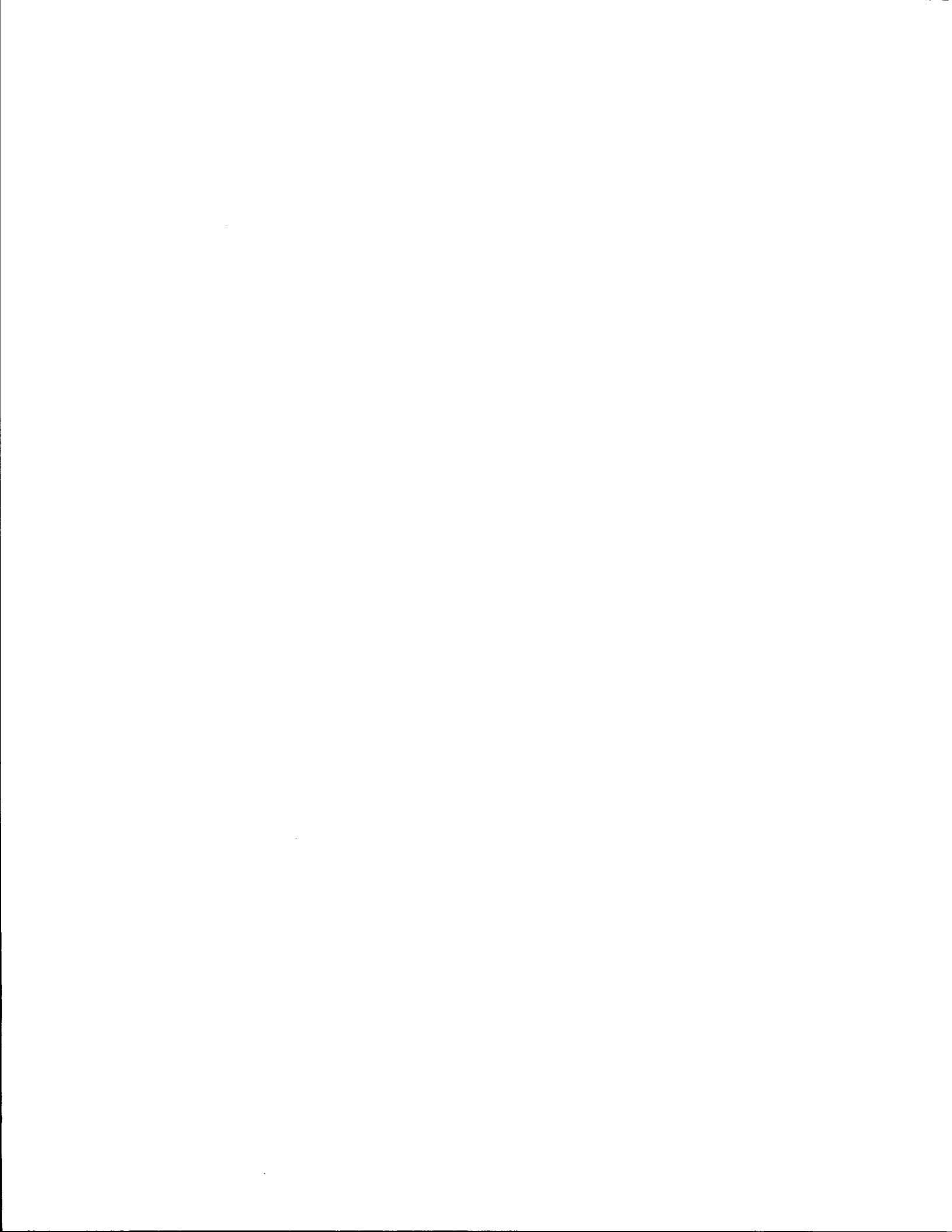


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6. "PASSER III-84," Texas Department of Highways and Public Transportation, November 1985.
7. Messer, Carroll J., Fambro, Daniel B. "A Guide for Designing and Operating Signalized Intersections in Texas." Report No. TTI-2-18-75-203-1. College Station, Texas: Texas Transportation Institute, Texas A&M University, August 1975.
8. "Highway Capacity Manual." Transportation Research Board Special Report 209, Washington, D.C.: Transportation Research Board, National Research Board, 1985.



**APPENDICES**



**APPENDIX A**  
**CONFIGURING PASSER III-88 FOR YOUR SYSTEM**





## CONFIGURING PASSER III-88 FOR YOUR SYSTEM

This section is intended for those users who wish to install their own configurations for PASSER III-88. The concepts related to the configuration of PASSER III-88 are discussed first. The discussion of these concepts is then supplemented by several examples which include those configurations that are supplied on the PASSER III-88 distribution diskette.

PASSER III-88 consists of four permanent files which include a user-friendly menu program, a program which contains the overlays for the menu, a file which does calculations, and a batch file that is used to configure the system. These files are listed below:

PSR3MENU.COM	(The Menu program)
PSR3MENU.000	(Overlay files for the Menu program)
XXPASS3.EXE	(Program which performs calculations)
PASSER3.BAT	(It tells the Menu program where to look for other files)

In addition, PASSER III-88 creates several files at the time it executes. Some of these files are created by you and are retained until you delete them. Other files are temporarily created by the program and deleted before the end of the execution. The following temporary files are created by PASSER III-88 at execution time:

P3FT0001.DAT	(Temporary data set read by XXPASS3.EXE)
P3FT0001.OUT	(Temporary output written by XXPASS3.EXE)
T7.TMP	(Temporary intermediate file used by XXPASS3.EXE)

These names are reserved for use by the PASSER III-88 program. You should never use these names for their data files.

Configuring the PASSER III-88 program means deciding where you want to store these files and providing the program with that information. This information is given to the program in the file PASSER3.BAT. The default content of this batch file is the following single command:

**PSR3MENU**

This command executes the menu program from the default disk drive and is equivalent to the following command:

**PSR3MENU /tOption /wOption /oOption /dOption /eOption**

Where **Option** is an optional path and/or filename. Default values are provided by the program in the absence of these options. These default values are described below:

**/t** - Drive and/or path for temporary files P3FT0001.DAT, P3FT0001.OUT, and T7.TMP. The default value is C:\PASSER3\DATA\  
**/w** - Drive and/or path for user defined data and output files. The default value is C:\PASSER3\DATA\.

**/o** - Path for PSR3MENU.000 file. The default value is /t.  
**/d** - Work data set and output file name. The default value is EXAMPLE.  
**/e** - Full specification of executable file. The default value is C:\PASSER3\XXPASS3.EXE.

Note that if the optional path and/or filenames following PSR3MENU do not exist, a system error will occur. You should verify that all path and/or filenames used in the PASSER3.BAT file exist before executing PASSER III-88.

If you wish to specify the work file name when entering the PASSER III-88 microcomputer environment system, the **/d** option in the PASSER3.BAT file should be replaced by **/d%1**. This parameter enables the program to accept the optional work file name that are user specified. Note that the work file name must be given without .DAT or .OUT extension. To execute the PASSER III-88 program, the following command should be used:

**A:\>PASSER3 filename**

The following examples explain the above described concepts in detail. These examples cover some common configurations you may want to select from for configuring the program in your system.

#### **EXAMPLE 1 : HARD DRIVE SYSTEM CONFIGURATION PROVIDED ON DISTRIBUTION DISKETTE.**

The HARD.BAT file contains the following executable lines:

```
CD \PASSER3
PSR3MENU /d%1
CD \
```

The install program (HDINST.BAT) supplied on the distribution diskette stores this file on both the ROOT directory and PASSER3 sub-directory under the new name PASSER3.BAT. The program is executed from either of the above two directories by typing PASSER and pressing the <Enter> key. The first line changes the default directory from C:\ to C:\PASSER3. The second line executes the PSR3MENU from the current default directory. Since all options except the /d option are omitted, the program uses default values for the parameters described earlier. The %1 after /d (a DOS option) allows you to specify a work file name instead of using the default name, EXAMPLE, which is assumed if no file name is typed after C:\>PASSER3. If at run time you type the command:

**C:\>PASSER3 TEST**

the program uses TEST.DAT and TEST.OUT as the work files. The work file name can also be changed using the FILE option from the MAIN MENU. The third line returns DOS to the root directory from which the program was executed.

**EXAMPLE 2 : TWO FLOPPY DRIVE SYSTEM CONFIGURATION PROVIDED ON DISTRIBUTION DISKETTE.**

The FLOPPY.BAT file allows the creation of a bootable floppy disk version of PASSER III-88. The file contains the following executable lines:

```
B:
PSR3MENU /wB:\ /tB:\ /d%1 /eA:\XXPASS3.EXE
A:
```

The install program (FLOPINST.BAT) copies this file on the bootable diskette labeled Disk A. The program is executed by typing PASSER3 at the A:\> prompt. The first line changes the default drive from A to B. The second line executes the PSR3MENU program from the current default drive and instructs it to work with files as described below:

Files P3FT0001.DAT, P3FT0001.OUT, T7.TMP, WORK.DAT, and WORK.OUT on the root directory of the disk in drive B.

File XXPASS3.EXE on the root directory of the disk in drive A.

Files PSR3MENU.COM and PSR3MENU.000 on the root directory in drive B. Note that by default, the location of file PSR3MENU.000 is assumed to be the same as that of work files.

The third line changes the default drive from B to A from which the program was executed.

**EXAMPLE 3 : TWO-FLOPPY SYSTEM CONFIGURATION THAT ALLOWS ALL PASSER III-88 PERMANENT FILES TO BE STORED ON ONE FLOPPY DISKETTE.**

The PASSER III-88 system can be configured so that the XXPASS3.EXE, PSR3MENU.COM, PSR3MENU.000, and PASSER3.BAT files are on a single floppy diskette in drive A, and all the data, output, and temporary files are on another disk in the drive B. This is done by replacing the contents of PASSER3.BAT file with the following three lines:

```
A:
PSR3MENU /oA:\ /wB:\ /tB:\ /d%1 /eA:\XXPASS3.EXE
A:
```

The difference between this file and the one given in Example 2 is that in this case the /o option is used to indicate that the PSR3MENU.000 file is on the diskette in drive A.

Note that if you use this configuration, drive B must contain a formatted floppy disk in order for the program to work. The diskette is not required to have any data sets on it. The data diskette in drive B can be replaced by another data diskette as desired.

**EXAMPLE 4 : CONFIGURATION THAT ALLOWS ALL FILES TO BE STORED IN ONE LOCATION.**

PASSER III-88 can be configured so that all files are stored in a single directory. This may be desirable if the computer has a hard drive or high density floppy disk drive.

For example, if all files are to be in the root directory of a high density diskette and TEST were to be the default work filename, the following steps should be taken. Copy PSR3MENU.COM, PSR3MENU.000, and XXPASS3.EXE into the root directory of the diskette. In the same directory, create a PASSER3.BAT file with the following single line:

```
PSR3MENU /oA:\ /wA:\ /tA:\ /dTEST /eA:\XXPASS.EXE
```

The path A:\ in the above line can be replaced by any valid path (e.g. C:\ or C:\SIGNAL). Note that the path and name of the work file can be changed by selecting the FILE option from the MAIN MENU and typing the new path and/or file name; thus, allowing the use of data and storage of output on other drives and/or directories as long as file names have an extension of .DAT or .OUT.

**APPENDIX B**  
**INTERACTIVE ERROR MESSAGES**



## INTERACTIVE ERROR MESSAGES

File EXAMPLE.DAT not defined.  
Only Output Option can be used.  
PRESS ANY KEY TO CONTINUE.

The specified work file, in this case EXAMPLE, has no data associated with it. Another work file must be specified if Edit, Run, or Input option is desired.

File EXAMPLE.OUT not defined.  
Use Edit or File, and/or  
Run Option to do so.  
PRESS ANY KEY TO CONTINUE.

The specified work file, in this case EXAMPLE, has no output associated with it. An output file must be created using the Run option or a work file having an output must be specified.

File EXAMPLE.DAT not defined.  
Use Edit or File Option to do so.  
PRESS ANY KEY TO CONTINUE.

The current work file, in this case EXAMPLE, has no data file associated with it. A data file must be created using the Edit option, or a work file having a data file must be specified using the File option, before the Run or Input option can be used.

Allowable Range from XXX to XXX.  
PRESS ANY KEY TO CONTINUE.

Data is out of allowable range. A value in the specified range must be entered.

INVALID OFFSET VALUE.  
Offset must be between zero and the  
lower cycle limit. The field may  
be left blank if a forced offset  
is not desired.  
PRESS ANY KEY TO CONTINUE.

The value of offset is invalid. If a value is entered, it must be greater than zero and less than the lower cycle limit.

FRONTAGE ROAD DATA NOT APPLICABLE  
WITH SINGLE INTERSECTION.  
PRESS ANY KEY TO CONTINUE.

Progression Option available on Edit Menu is applicable to multiple interchange problems only. Another option must be selected for an isolated interchange.

FILE PSR3TEMP.&&& ERROR, Drive may be Full. CORRECT THE PROBLEM AND RERUN.  
PRESS ANY KEY TO CONTINUE.

Writing a file, in this case PSR3TEMP.&&&, to the disk is not possible because of insufficient disk space. Copy the data to another disk or delete some files from the current disk to ensure the availability of required disk space. The problem must be rerun after the above corrective action has been taken.

PASSER III has detected a SYSTEM ERROR  
TYPE ==> X, NUMBER ==> XX  
ADDRESS ==> XXXX, MODULE ==> PSR3MENU  
Record the information before calling  
for system support!!  
Hit Any Key to EXIT to the Operating  
System.

This type of error causes the program to terminate. In case this happens, record the information given in the error message and supply this information to the system support group. In addition, the contents of the PASSER3.BAT file and the hardware configuration of your computer system will also be required. Also, try to recreate the conditions under which the error occurred and supply a description of what was being done when the error occurred.

No Output Data in this Section!  
Press <ESC> to continue.

This particular output option was not requested; therefore, there is no available output data in this section. Use a valid option.



**APPENDIX C**  
**SIGNAL TIMING AND MEASURES OF EFFECTIVENESS CALCULATIONS**



## SIGNAL TIMING AND MEASURES OF EFFECTIVENESS CALCULATIONS

The fixed-time cycle length, green split, and measures of effectiveness calculations that are used by the PASSER III-88 program are illustrated in this appendix. The measures of effectiveness that are calculated by the program include: volume-to-capacity ratio, average vehicular delay, interior queue storage ratio, and progression efficiency and attainability.

### Calculating Fixed Time Cycle Lengths and Green Splits

$$C = [(1.5 * L) + 5] / (1 - Y) \quad [1]$$

where: C = Cycle length, sec.

$$L = \sum_{i=1}^n l_i, \quad n = \text{number of phases.}$$

$l_i$  = Lost time per phase, sec. The recommended value is 4 seconds.

$$Y = \sum_{i=1}^n y_i, \quad n = \text{number of phases.}$$

$y_i$  = The ratio between the actual demand volume and the saturation capacity flow rate for each phase.

To calculate green splits:

$$G_i = [(y_i / Y) * (C - L)] + l_i \quad [2]$$

Note: Each intersection of a diamond interchange will generally have a different optimal cycle length. The smallest permissible cycle length for the interchange should not be less than 0.85 times the larger optimal cycle length, nor normally be greater than 1.25 times the smaller optimal cycle length for the interchange. For example, assume that the optimal cycle lengths based on the Webster formula, for the two intersections which make up the diamond interchange are 45 and 50 seconds. The smallest permissible cycle length for the interchange should not be less than  $(0.85 \times 50) = 43$  seconds nor greater than  $(1.25 \times 45) = 56$  seconds.

If the frontage road progression option is being utilized, the smallest and largest cycle lengths the program considers in finding the optimal solution must be determined beforehand. The smallest permissible cycle length for the frontage road system should not be less than 0.85 times the largest optimal cycle length of any individual intersection in the system, nor normally be greater than 1.25 times the smallest optimal cycle length of any individual intersection in the system.

## Calculating Operational Measures of Effectiveness

- Demand volume to signal capacity ratio,  $x$ .

$$X = (Q * C) / (S * g) \quad [3]$$

where:  $X$  = Demand volume to signal capacity ratio for the critical lane on the approach.

$Q$  = Average arrival rate for the critical lane on the approach, veh./hr.

$C$  = Interchange cycle length, sec.

$S$  = Saturation capacity flow rate for the critical lane on the approach, veh./hr.

$g$  = Length of the effective green phase on the approach, sec.

and  $g = G - l \quad [4]$

where:  $G$  = Length of the green plus yellow phases on the approach, sec.

$l$  = Lost time per phase, sec. The program assumes a value of 4 seconds per phase.

- Total vehicular delay,  $d$ .

$$d_1 = \frac{0.5C [1 - g/C]^2}{[1 - (g/C) * (X)]} \quad [5]$$

$$d_2 = 225 X^2 [ (X-1) + \sqrt{(X-1)^2 + (16 X/c)} ] \quad [6]$$

$$d = d_1 + d_2 \quad [7]$$

where:  $d_1$  = Uniform delay, sec./veh.

$d_2$  = Incremental delay, sec./veh.

$d$  = Total delay per vehicle for the lane group, sec./veh.

$C$  = Cycle length, sec.

Note: These equations have been multiplied by 1.3 in order to convert stopped delay to total delay from equation 11-2 "Highway Capacity Manual," Special Report 209, Transportation Research Board, 1985.

and  $g/C$  = Green ratio for the lane group; the ratio of effective green time to cycle length.

where:  $X$  =  $V/c$  ratio for the lane group.

$c$  = Capacity of the lane group.

- Interior storage ratio,  $S$ .

$$S_R = Q_M / S_A \quad [8]$$

where:  $S_R$  = Interior storage ratio.

$Q_M$  = Maximum queue per cycle on the approach, veh.

$S_A$  = Available storage capacity on the approach, veh.

- Efficiency,  $E$

$$E = \frac{B_a + B_b}{2C} \quad [9]$$

where:  $E$  = Progression bandwidth efficiency, ratio

$B_a$  = Progression bandwidth in "A" direction, sec.

$B_b$  = Progression bandwidth in "B" direction, sec.

$C$  = Cycle length, sec.

- Attainability,  $A$

$$A = \frac{B_a + B_b}{MING_a + MING_b} \quad [10]$$

where:  $A$  = Progression bandwidth attainability, ratio

$B_a$  = Progression bandwidth in "A" direction, sec.

$B_b$  = Progression bandwidth in "B" direction, sec.

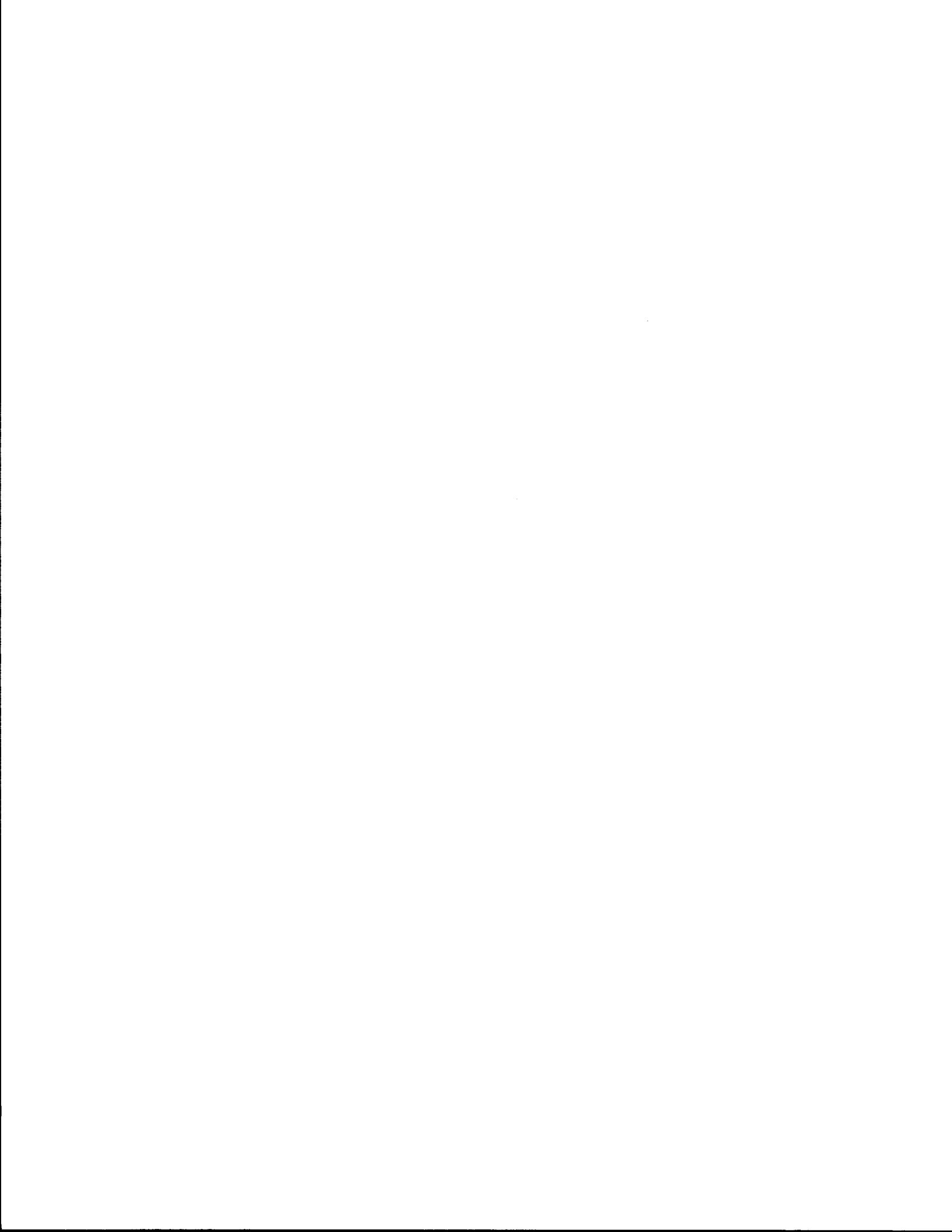
$MING_a$  = Minimum green time in "A" direction, sec.

$MING_b$  = Minimum green time in "B" direction, sec.



**APPENDIX D**

**RELATIONSHIPS BETWEEN PASSER III PHASING CODES  
AND PRETIMED DIAMOND INTERCHANGE PHASING**





## RELATIONSHIPS BETWEEN PASSER III PHASING CODES AND PRETIMED DIAMOND INTERCHANGE PHASING

This appendix illustrates the relationships between the various combinations of phasings codes used by PASSER III-88 and the pretimed signal sequences commonly used at diamond interchanges. These relationships are especially useful when evaluating existing signal timing plans or trying to implement PASSER III results. As shown in Table D-1 and illustrated on the following pages, green splits of some predetermined length are used to calculate the internal offset that should be input to the program.

If the existing phasing code and signal timing are known, this is a relatively simple computation, existing splits at the left and right side intersections are used, as shown in Table D-1, to calculate the appropriate internal offset. This value is entered next to the desired phasing code in PASSER III. Existing volumes and saturation flow rates are then entered along with minimum phase times equal to the existing green splits.

If the green splits are not known, a two step procedure should be followed. First, optimum green splits should be calculated without regard to offset by inputting the volumes, saturation flow rates, and minimum allowable phase times and then running the program. Second, use the calculated green splits at the left and right side intersections to compute the appropriate internal offset and rerun the problem with the original data except for internal offset and minimum phase times that are equal to the calculated green splits.

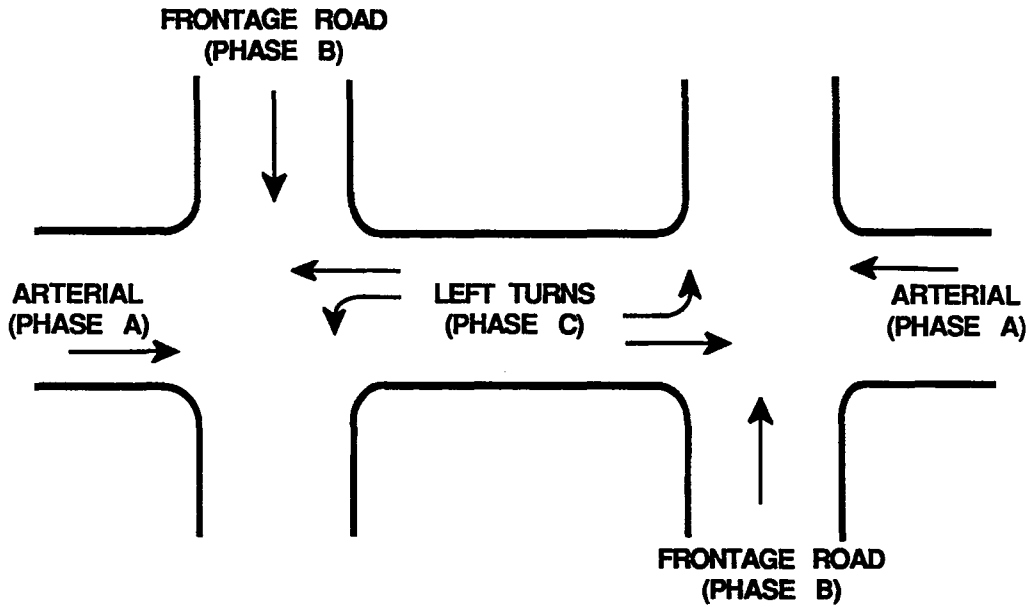
Table D-1. Required Internal Offsets to Produce Common Three- and Four-Phase Diamond Interchange Signal Phasing.

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1.	Lead-Lead (ABC/ABC) or Lead-Lag (ABC/ACB) Internal Offset = Left Side Phase A + Right Side Phase B
2.	Lag-Lead (ACB/ABC) or Lag-Lag (ACB/ACB) Internal Offset = Left Side Phase A + Left Side Phase C + Right Side Phase B
3.	TTI - Lead (ABC/ABC) Internal Offset = Travel Time - Two (2) Seconds

---

# PHASING CODE DESCRIPTIONS USED BY PASSER III-88

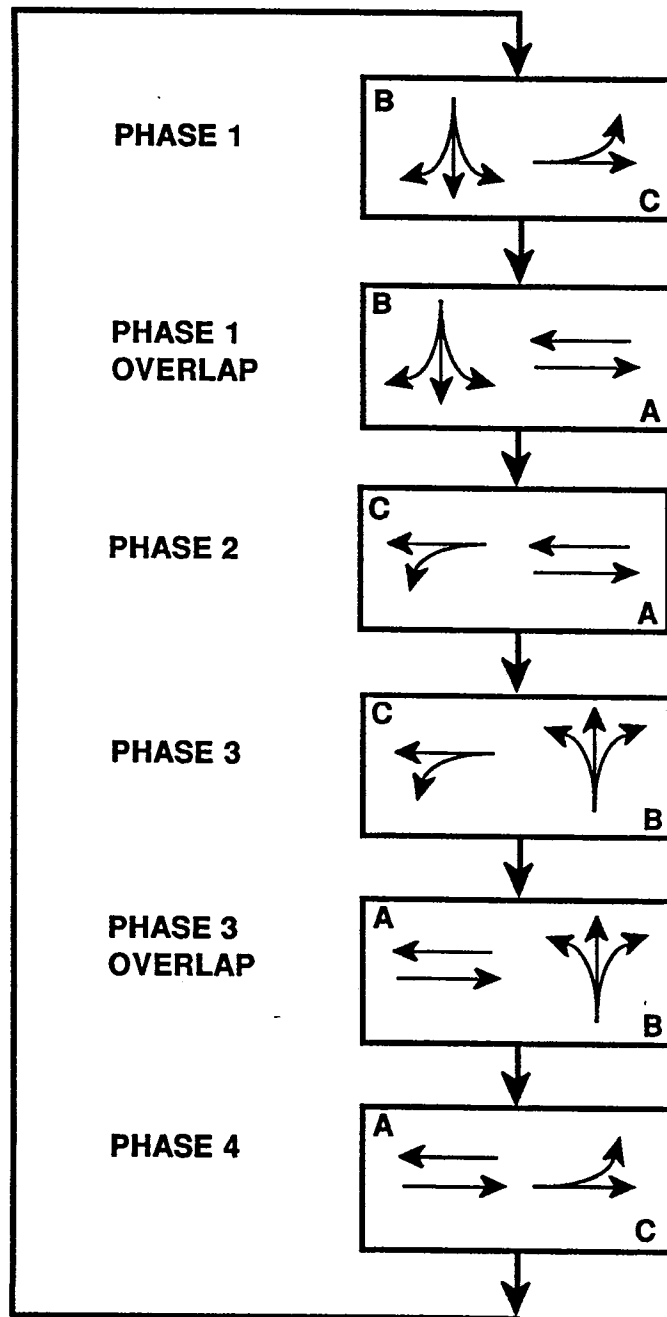


PHASING CODE	LEFT SIDE PHASE SEQUENCE			LEFT TURN SEQUENCE	RIGHT SIDE PHASE SEQUENCE		
1				LEAD-LEAD			
2				LAG-LEAD			
3				LEAD-LAG			
4				LAG-LAG			
1A				TTI-LEAD			

# THREE-PHASE PRETIMED DIAMOND INTERCHANGE PHASING

PHASE NO.	BASIC THREE PHASE	FAVOR WEST SIDE	FAVOR EAST SIDE
1			
2			
3			

# FOUR-PHASE PRETIMED DIAMOND INTERCHANGE PHASING



**APPENDIX E**  
**SATURATION FLOW RATE CALCULATIONS**



## SATURATION FLOW RATE CALCULATIONS

This appendix illustrates procedures that can be used to calculate saturation flow rates for each of the 18 movements required by PASSER III-88. The four cases examined are as follows:

1. Exclusive lane assignments (3 lanes - 3 lane groups);
2. Shared lane assignments (3 lanes - 2 lane groups);
3. Shared lane assignments (3 lanes - 1 lane group); and
4. Shared lane assignments (3 lanes - 2 lane groups) with defacto turn lane.

The basis for the calculations of saturation flow rates is Equation 9-8 in the 1985 Highway Capacity Manual (8). This equation is shown below:

$$s = s_0 * N * f_w * f_{HV} * f_g * f_p * f_{bb} * f_a * f_{RT} * f_{LT}$$

where:

$s$  = Saturation flow rate for the subject lane group, expressed as a total for all lanes in the lane group under prevailing conditions, in vphg.

$s_0$  = Ideal saturation flow rate per lane, usually 1,800 pcphgpl.

$N$  = Number of lanes in lane group.

$f_w$  = Adjustment factor for lane width (12-ft lanes are standard), given in Table 9-5.

$f_{HV}$  = Adjustment factor for heavy vehicles in the traffic stream, given in Table 9-6.

$f_g$  = Adjustment factor for approach grade, given in Table 9-7.

$f_p$  = Adjustment factor for the existence of a parking lane adjacent to the lane group and the parking activity in that lane, given in Table 9-8.

$f_{bb}$  = Adjustment factor for the blocking effect of local buses stopping within the intersection area, given in Table 9-9.

$f_a$  = Adjustment factor for area type, given in Table 9-10.

$f_{RT}$  = Adjustment factor for right turns in the lane group, given in Table 9-11.

$f_{LT}$  = Adjustment factor for left turns in the lane group, given in Table 9-12.

The following examples involve only the south-side frontage road (eastbound approach) of the diamond interchange shown in Figure E-1. These examples demonstrate the effects of both exclusive and shared lane assignments. The same procedures should be used for the other approaches as well.

Turning movements, or an estimate thereof, are required to determine the saturation flow rates for PASSER III-88. If different movements share a common lane, the saturation flow rates must have the same proportions as the volumes. Figure E-1 illustrates the AM peak (PM peak) hour volumes, of a typical diamond interchange, that will be used to illustrate the calculation of saturation flow rates.

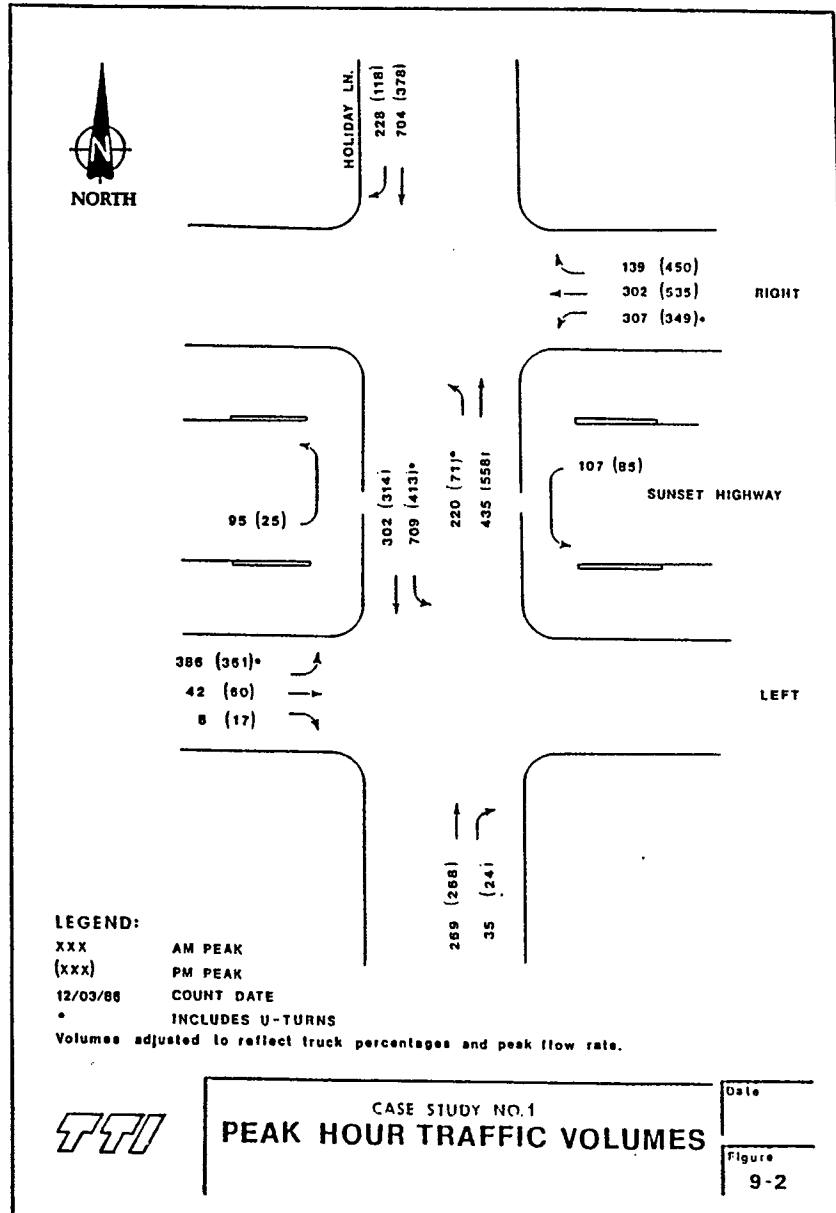


Figure E-1. Peak Hour Traffic Volume.



The following calculations illustrate how to determine the volumes for each of the 18 movements required by PASSER III-88. These calculations are based on the turning movements at the south side of the interchange shown in Figure E-1, on the preceding page. The same procedure should also be used for the right side of the interchange.

<u>Approach</u>	<u>Calculation</u>	<u>Volume</u>
<b>Cross-Street</b>		
Northbound Right-Turn		35
Northbound Straight-Through	435 - (386-95)	144
Northbound Straight-Then-Left	269 - 144	125
<b>Frontage Road</b>		
Eastbound Right-Turn		8
Eastbound Straight-Through		42
Eastbound Left-Then-Straight	386 - 95	291
Eastbound Left-Then-Left		95
<b>Interior</b>		
Southbound Left-Turn		709
Southbound Straight-Through		302

The interchange movement data input screen from PASSER III-88 is shown below to illustrate the volumes once they have been entered into the program.

P A S S E R   I I I   -   8 8 Version 1.0  
 Texas Department of Highways & Public Transportation

HOLIDAY LANE

Vol/ Hour	Sat Flow	Min Phase		Vol/ Hour	Sat Flow	Min Phase
35	340		CROSS-STREET	228	1150	
144	1400	20	right-turn	102	520	56
125	1800		straight-through	602	1800	
			straight-then-left			
			FRONTAGE ROAD			
8	560		right-turn	139	1090	
42	2950	38	straight-through	302	2360	26
291	1150		left-then-straight	200	995	
95	380		left-then-left	107	533	
			INTERIOR			
709	1710	62	left-turn	220	1710	38
302	1800	62	straight-through	435	1800	38

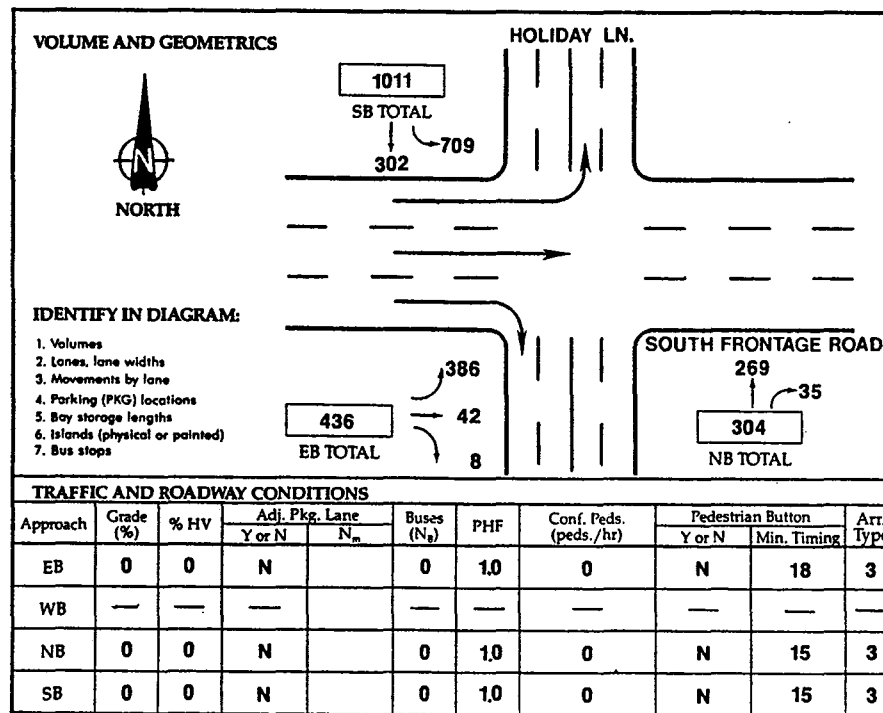
Esc:exit screen      PgUp/PgDn:next interchange

The following examples illustrate some of the different conditions that may exist in the field. For each case, the saturation flow rates are calculated based on the turning volumes and lane assignments that are present.

**CASE 1: EXCLUSIVE LANE ASSIGNMENTS (3 LANES - 3 LANE GROUPS)**

Case 1 illustrates a condition where the lanes are assigned one movement only. The inside lane is restricted to left turns; the middle lane to through movements; and the outside lane to right turns.

1. The first step is to calculate the saturation flow rate for each lane group based on geometrics and roadway conditions (see figure below).



Lane Group	Lane	Sat. Flow	No. Lanes	f <sub>W</sub>	f <sub>HV</sub>	f <sub>G</sub>	f <sub>P</sub>	f <sub>BB</sub>	f <sub>A</sub>	f <sub>RT</sub>	f <sub>LT</sub>	Adj. Sat. Flow
EB	L	1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1710
	T	1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1800
	R	1800	1	1.00	1.00	1.00	1.00	1.00	1.00	0.85	1.00	1530

2. Since more than one left-turn movement occurs from the left lane, the saturation flow rates for the left-turn movements have to be proportioned from the saturation flow rate for the lane group.

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---

<u>Movement</u>	<u>Calculation</u>	<u>Saturation Flow Rate (vphg)</u>
Left-Then-Left	$1710 * [95/(291+95)]$	421
Left-Then-Straight	$1710 * [291/(291+95)]$	1289
Straight-Through		1800
Right-Turn		1530

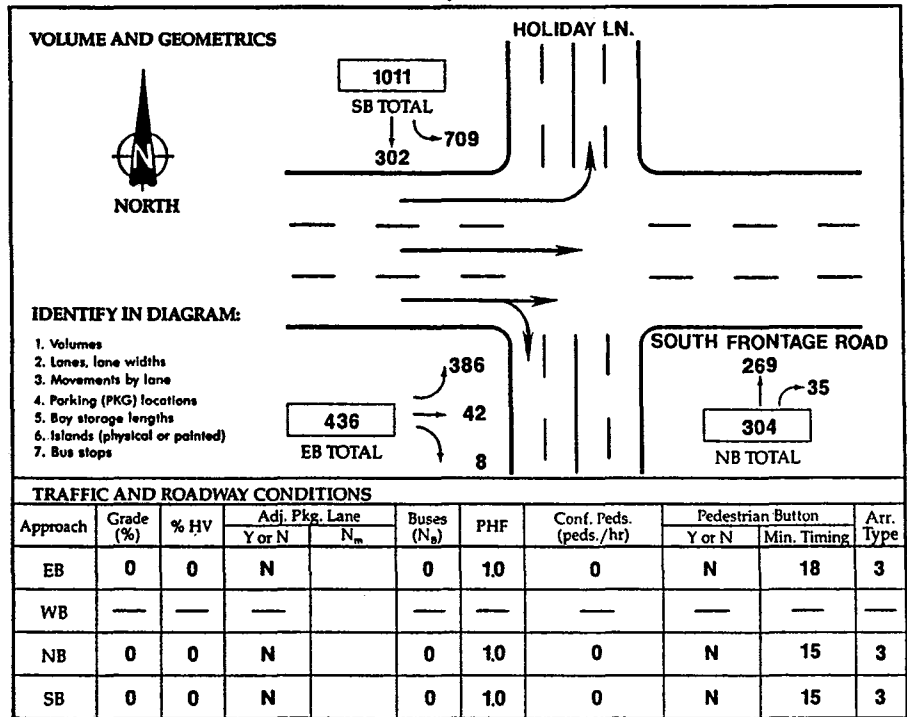
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**CASE 2: SHARED LANE ASSIGNMENT (3 LANES - 2 LANE GROUPS)**

Case 2 illustrates the condition of shared lane operations in a single lane. The inside and middle lanes are restricted to left and through movements, respectively. The outside lane is marked as an optional lane to allow through and right-turn movements.

1. The first step is to calculate the saturation flow rate for each lane group based on geometrics and roadway conditions (see figure below).



Lane Group	Ideal Sat. Flow	No. Lanes	f <sub>W</sub>	f <sub>HV</sub>	f <sub>G</sub>	f <sub>P</sub>	f <sub>BB</sub>	f <sub>A</sub>	f <sub>RT</sub>	f <sub>LT</sub>	Adj. Sat. Flow
L	1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1710
EB TR	1800	2	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	3528

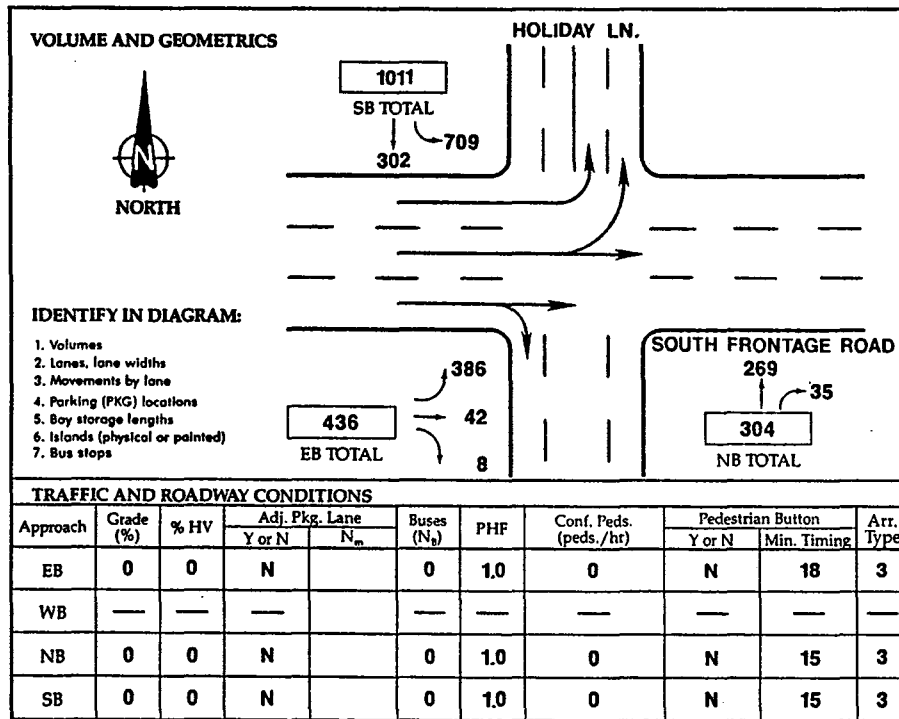
2. Since more than one movement occurs from each lane group, the saturation flow rates for individual movements have to be proportioned from the saturation flow rate for the lane group.

<u>Movement</u>	<u>Calculation</u>	<u>Saturation Flow Rate (vphg)</u>
Left-Then-Left	$1710 * [95/(291+95)]$	421
Left-Then-Straight	$1710 * [291/(291+95)]$	1289
Straight-Through	$3528 * [42/(42+8)]$	2964
Right-Turn	$3528 * [8/(42+8)]$	564

**CASE 3: SHARED LANE ASSIGNMENTS (3 LANES - 1 LANE GROUP) WITH CAPACITY CONSTRAINT**

Case 3 illustrates shared lane operations occurring in two lanes. The inside lane is an exclusive left-turn lane, and the outer two lanes are shared lanes. The middle lane is shared between lefts and throughs, and the outside lane is shared between throughs and rights.

1. The first step is to calculate the saturation flow rate for each lane group based on geometrics and roadway conditions (see figure below).



Lane Group	Ideal Sat. Flow	No. Lanes	f <sub>W</sub>	f <sub>HV</sub>	f <sub>G</sub>	f <sub>P</sub>	f <sub>BB</sub>	f <sub>A</sub>	f <sub>RT</sub>	f <sub>LT</sub>	Adj. Sat. Flow
EB LTR	1800	3	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.96	5080

2. Since there is only one lane group for this approach, the saturation flow rates for all movements have to be proportioned from the saturation flow rate for the lane group.

<u>Movement</u>	<u>Calculation</u>	<u>Saturation Flow Rate (vphg)</u>
Left-Then-Left	5080 * (95/436)	1107
Left-Then-Straight	5080 * (291/436)	3391
Straight-Through	5080 * (42/436)	489
Right-Turn	5080 * (8/436)	93

3. From the above results, the calculated saturation flow rates for the left-turn movements exceed the ideal saturation flow rate for two lanes. In this case, the saturation flow rates should be recalculated with the inner two lanes as defacto left-turn lanes. These calculations are shown below.

Lane Group	Ideal Sat. Flow	No. Lanes	f W	f HV	f G	f P	f BB	f A	f RT	f LT	Adj. Sat. Flow
*L	1800	2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	3312
EB TR	1800	1	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1764

\*Defacto left-turn lanes

4. Since more than one movement occurs from each lane group, the saturation flow rates for each movement has to be proportioned from the saturation flow rates for the lane group.

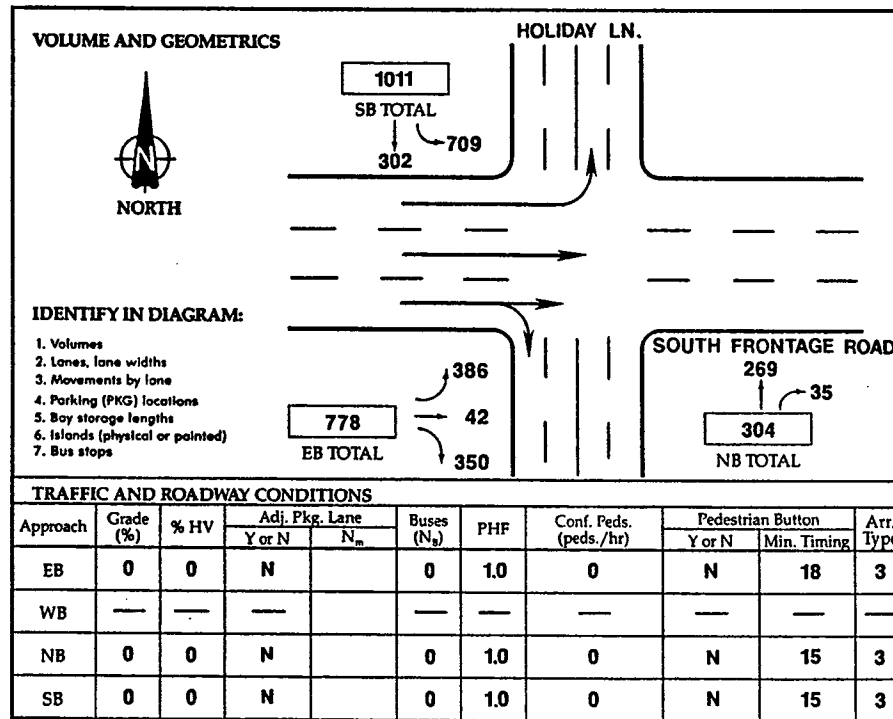
<u>Movement</u>	<u>Calculation</u>	<u>Saturation Flow Rate (vphg)</u>
Left-Then-Left	$3312 * (95/386)$	815
Left-Then-Straight	$3312 * (291/386)$	2497
Straight-Through	$1764 * (42/50)$	1482
Right-Turn	$1764 * (8/50)$	282



**CASE 4: SHARED LANE ASSIGNMENT (3 LANES - 2 LANE GROUPS) WITH CAPACITY CONSTRAINT**

Case 4 illustrates the condition in which there is a large number of turns occurring from a shared lane (350 right turns). This condition sometimes causes the shared lane to become a defacto turn lane.

1. The first step is to calculate the saturation flow rate for each lane based on geometrics and roadway conditions (see figure below).



Lane Group	Ideal Sat. Flow	No. Lanes	f <sub>W</sub>	f <sub>HV</sub>	f <sub>G</sub>	f <sub>P</sub>	f <sub>BB</sub>	f <sub>A</sub>	f <sub>RT</sub>	f <sub>LT</sub>	Adj. Sat. Flow
L	1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1710
EB TR	1800	2	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	3132

2. Since more than one movement occurs from each lane group, the saturation flow rates for individual movements have to be proportioned from the saturation flow rate for the lane group.

<u>Movement</u>	<u>Calculation</u>	<u>Saturation Flow Rate (vphg)</u>
Left-then-Left	$1710 * [95/(291+95)]$	421
Left-then-Straight	$1710 * [291/(291+95)]$	1289
Straight-Through	$3132 * [42/(42+350)]$	336
Right-Turn	$3132 * [350/(42+350)]$	2796

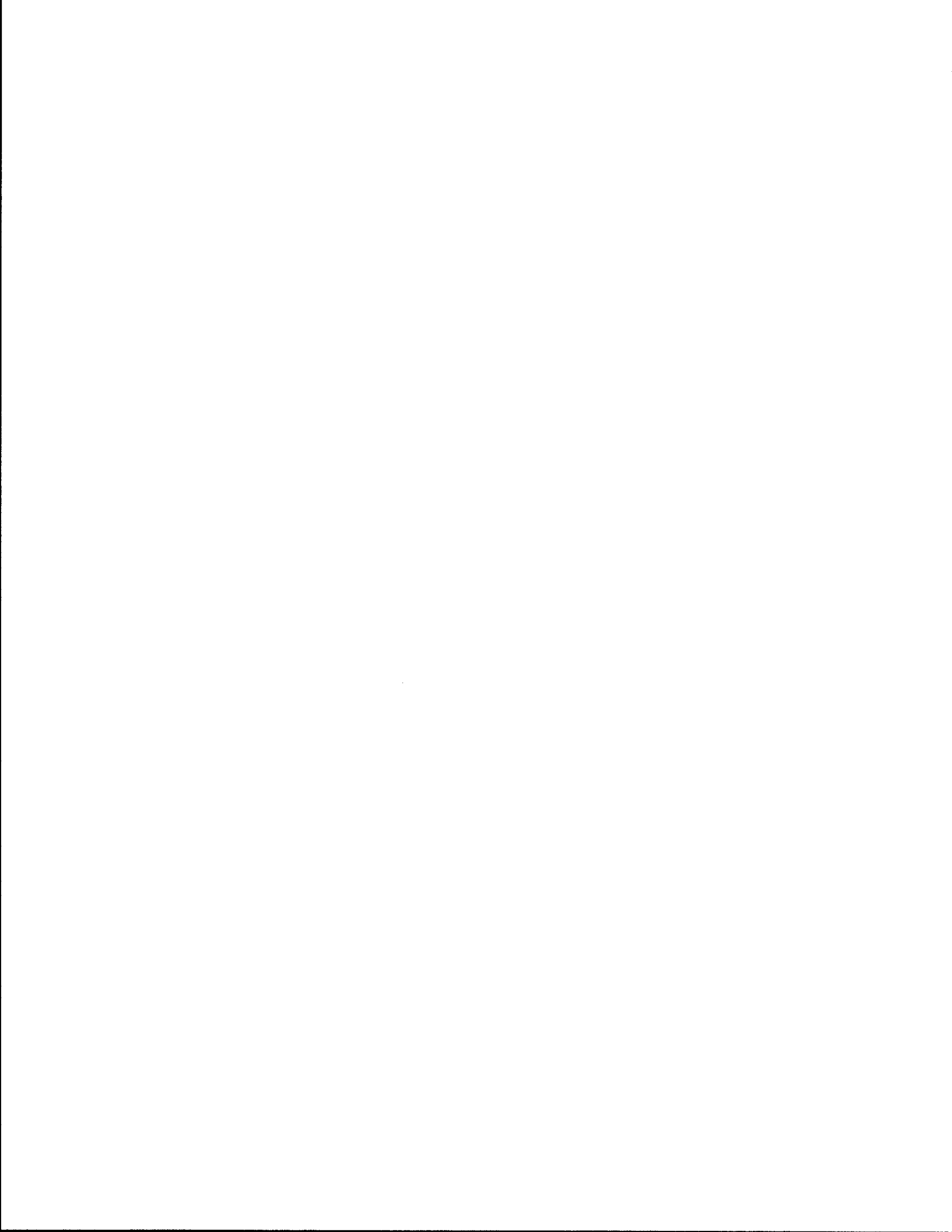
3. From the above results, the calculated saturation flow rate for the right-turn movement exceeds the ideal saturation flow rate for one lane. In this case, the saturation flow rates should be recalculated with the outer lane as an exclusive right-turn lane. These calculations are shown below.

Lane Group	Ideal Sat. Flow	No. Lanes	f W	f HV	f G	f P	f BB	f A	f RT	f LT	Adj. Sat. Flow
EB	L	1800	1	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1710
	T	1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1800
	*R	1800	1	1.00	1.00	1.00	1.00	1.00	0.85	1.00	1530

\* Defacto right-turn lane

4. Since more than one movement occurs from each lane group, the saturation flow rates for individual movements have to be proportioned from the saturation flow rate for the lane group.

<u>Movement</u>	<u>Calculation</u>	<u>Saturation Flow Rate (vphg)</u>
Left-Then-Left	$1710 * [95/(95+291)]$	421
Left-Then-Straight	$1710 * [291/(95+291)]$	1289
Straight-Through		1800
Right-Turn		1530



**APPENDIX F**  
**FORTRAN WARNING AND ERROR MESSAGES**



## FORTRAN WARNING AND ERROR MESSAGES

### FORTRAN Warning Messages.

The FORTRAN warning messages are printed on the output produced by the PASSER III-88 program. These messages do not stop program execution; however, the results obtained may not accurately reflect your desired solution. The messages and possible actions in this category are listed below:

**\*\* WARNING \*\*** NO FOUR-PHASE OVERLAP SOLUTION POSSIBLE FOR INTERCHANGE XXX.  
CYCLE LENGTH (XXX SEC) IS TOO SHORT.

Possible Action. Increase the lower cycle length if a four-phase overlap solution is desired.

**\*\* WARNING \*\*** V/C RATIO FOR MOVEMENT XXX AT INTERCHANGE XXX EXCEEDS 5.0.  
QUEUE LENGTH AND DELAY ESTIMATES MAY NOT BE ACCURATE.

Possible Action. Check volume and capacity data for errors. If no errors, either take measures to decrease volume or increase capacity.

**\*\* WARNING \*\*** INTERIOR MOVEMENT XX AT INTERCHANGE XXX IS SUPERSATURATED.  
V/C RATIO IS EQUAL TO X.XX.

Possible Action. Check volume and capacity data for errors. If no errors, either take measures to decrease volume or increase capacity.

### FORTRAN Error Messages.

The FORTRAN error messages are caused by errors categorized as fatal. The occurrence of a fatal error(s) causes the execution of the program to stop. The program attempts to continue executing after printing an error message. It cannot, however, continue beyond a certain (number of errors) limit, which depends on the type of error(s) which occurred. At that time, it prints a listing of all errors and stops executing. The errors must be corrected in order for the program to execute. The following is a list of the PASSER III-88 error messages accompanied by possible corrective actions:

**\*\* ERROR \*\*** THE NUMBER OF INTERCHANGES MUST BE IN THE RANGE 1 TO 15. THE  
CURRENT VALUE IS XXX.

Possible Action. Enter value in the allowed range of 1 to 15 and run the program again.

**\*\* ERROR \*\*** LOWER CYCLE LENGTH MUST BE SUPPLIED.

Possible Action. Enter the value of lower cycle length and rerun.

**\*\* ERROR \*\*** DELAY-OFFSET OPTIMIZATION CANNOT BE REQUESTED FOR CYCLE LENGTHS GREATER THAN 150 SECONDS.

Possible Action. Either decrease the cycle length or use internal offset evaluation option.

**\*\* ERROR \*\*** AN INTERNAL OFFSET FOR XXXXXXXX PHASING AT INTERCHANGE XXX MUST BE PROVIDED IN ORDER TO EVALUATE THE EXTERNAL OFFSET.

Possible Action. Specify the optimization option or evaluate an internal offset.

**\*\* ERROR \*\*** AT INTERCHANGE XXX INTERNAL OFFSET OPTIMIZATION OR EVALUATION OPTION MUST BE SELECTED FOR AT LEAST ONE PHASING SEQUENCE.

Possible Action. Specify the optimization option or evaluate an offset.

**\*\* ERROR \*\*** DISTANCES AND DESIRED SPEEDS FOR THE FIRST INTERCHANGE MUST BE EQUAL TO ZERO.

Possible Action. Delete this information for the first interchange.

**\*\* ERROR \*\*** DISTANCES AND DESIRED SPEEDS FOR THE LAST INTERCHANGE MUST BE GREATER THAN ZERO.

Possible Action. Enter information for the last link.

**\*\* ERROR \*\*** AT LEFT SIDE OF INTERCHANGE XXX THE SUM OF MINIMUM CONFLICTING GREENS (XXX SEC) IS GREATER THAN THE LOWER CYCLE LENGTH (XXX SEC).

Possible Action. Check data for errors. If no errors, increase the lower cycle length value.

**\*\* ERROR \*\*** AT RIGHT SIDE OF INTERCHANGE XXX THE SUM OF MINIMUM CONFLICTING GREENS (XXX SEC) IS GREATER THAN THE LOWER CYCLE LENGTH (XXX SEC).

Possible Action. Check data for errors. If no errors, increase the lower cycle length value.

**\*\* ERROR \*\*** AT INTERCHANGE XX, THE ONLY SPECIFIED FOUR-PHASE OVERLAP OPTION IS NOT POSSIBLE FOR CYCLE LENGTH OF XXX. THE PROGRAM EXECUTION IS BEING STOPPED FOR THIS CYCLE LENGTH.

Possible Action. Increase the cycle length and/or specify another signal phasing option.

. The third line returns DOS to the root directory from which the program was